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VOLUME 110 NUMBER 5

P-99
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EDITORIAL

The Cover Photograph of this issue depicts the problem of heavy incidence of grazing in the alpine pastures situated in the upper reaches of the Himalayas during the summer months. There is urgent need to rehabilitate and develop the alpine pastures for ecological conservation for the preservation of the rare high altitude flora and fauna, for aesthetic beauty and for providing rich grazing grounds to the sheep, goats, and cattle, on which the hill economy is much dependent.

* * *

In the lead article of this issue the authors have proved through their experiment that hard seed coat of *Acacia nilotica* ssp. *indica* retards germination and pre-treatment with hot water gives the best results. They have found that out of the various provenances of *Acacia nilotica* ssp. *indica* var. *Jaquemonti*, Fazilka, Paratwara, Rohtak and Kurukshetra provenances give the best germination.

* * *

To-day there is a heavy demand for packing cases in Himachal Pradesh. On page 450 the author writes about the management of Spruce and Silver Fir Forests for packing boxes supply in Himachal Pradesh. He has also mentioned that manufacture of packing cases out of veneers will considerably reduce the wastage in sawing as demonstrated by the Forest Research Institute, Dehra Dun.

* * *

The author on page 458 suggests that grassy blanks in Sal Forests in frosty localities in Madhya Pradesh may be planted with Chir seeds of Supkhar Origin to increase the productivity of forests as it is a fast growing species and its rotation of maximum volume production is around 40 years.

* * *

On page 478 the authors describe the studies conducted by them on the physical work load in tree felling and cross cutting operations in the tropical rain forests of the West Coast in Karnataka State. The study also reveals that the energy costs of work can be reduced appreciably if the workers use improved hand saws than the traditional local axe and saw.

* * *

We are interested to know the dimensions of ***Biggest Trees*** of various species growing in our forests. Readers are requested to send us with full details nature of occurence, measurements, estimated age in years, botanical and common name, location (place, distt. and state), of such trees with photographs, if possible.

* * *

As already announced, the September, 1984 issue of the ***Indian Forester*** will be a Special Issue on ***FOREST BIOMASS.*** Readers are requested to contribute suitable articles and forward them to us immediately.

* * *

The readers are also requested to send us suitable colour transparencies for publication as front cover of the ***Indian Forester.***

* * *

The readers will be glad to know that a PL-480 Research Project IN-FS-73 "Studies on Induced Polyploidy and Mutagenesis in some Hardwood Tree Species" was completed successfully at Forest Research Institute and Colleges, Dehra Dun. The project has produced useful information that may be applicable for Tree Improvement Work in India. Recently comments from T.D. Rudolph, Principal Plant Geneticist, Cooperating Scientist of United States Department of Agriculture have also been made available on the project which read as follows :

"The research was done at the Radio Isotope Branch, Forest Research Institute and Colleges, Dehra Dun, India. The most recent Principal Investigator was Dr. M.L. Kapoor. The research period covered by the final report is December, 1, 1976 to November 30, 1981.

Three research areas were investigated : (1) Induced polyploidy; (2) Physical mutagenesis; and (3) Chemical mutagenesis. The induced polyploidy studies included colchicine treatment of seeds and axillary buds of three ***Eucalyptus*** species. Physical mutagenesis studies involved gamma irradiation of seed of three ***Eucalyptus*** species, ***Bombax ceiba***, and ***Dalbergia sissoo***. In the chemical mutagenesis studies, seeds of four *Eucalyptus* species, ***Bombax ceiba***, and ***Dalbergia sissoo*** were treated with ethylmethane sulphonate (EMS) or with nitrosomethyl urea (NMU).

The most suitable and effective concentrations of colchicine for inducing polyploidy were 0.5 to 1.0 per cent. Thick and dark green leaves with increased size of the stomata were found to be reliable diagnostic features for detecting tetraploids; leaf index and height of plants were not stable or reliable diagnostic features. Colchicine treatment of axillary buds was more effective in producing tetraploids than treatment of seed.

Studies on gamma irradiation of seed showed that ***Tectona grandis*** was more radiosensitive than the ***Eucalyptus*** species and ***Bombax ceiba*** was the most radio-resistant. Germination energy index, and radicle and hypocotyl length were the best parameters for determining the LD_{50} doses and other measures of radiosensitivity.

Of the two chemical mutagens studied NMU was much more effective than EMS and could be used at concentrations that were ten times lower than those for EMS. Germination energy index and radicle and hypocotyl length were again best for assessing the efficiency of chemical mutagenic treatment of seed.

The results of the studies indicate that mutation breeding and polyploidy breeding could be useful adjuncts to conventional breeding methods in the species studied and on related species.

The results may benefit U.S. forestry, particularly in sub-tropical and tropical areas where Eucalypts are being studied and tested. The methods developed for inducing polyploids could be used for producing tetraploids that would be crossed with diploids to produce triploids. Triploids have been shown to be much more vigorous than diploids in other hardwood tree species. Isoenzyme techniques can be applied to assess the mutations and variability induced by mutagenic treatments and to more efficiently screen for polyploids induced by colchicine treatment. Tissue culture and micropropagation techniques such as are being developed in the biotechnology program could be applied to propagate and multiply desired mutated tissue obtained through the mutagenic treatment methods described in this final report".

R.S. Mathur,
Hony. Editor.

GERMINATION BEHAVIOUR OF VARIOUS PROVENANCES OF *ACACIA NILOTICA* SSP. *INDICA*

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Introduction

There is considerable scope for the improvement of our indigenous economically important tree species that are relevent to the rural communities to meet their bonafide needs of fuel, fodder, fruit, fibre, etc. This calls for production of quality seeds of various species. In recent years much attention has been given to ***Acacia nilotica*** ssp. ***indica*** as one of the important species for afforestation of arid and semi-arid areas in India.

Acacia nilotica ssp. ***indica*** occur extensively on a wide strip from North to South of the country under varied ecological conditions. It is widely planted and selfsown throughout dry, hot regions of India. The absolute shade temperature varies from 40°C to 46°C during summer and the absolute minimum from 1°C to 15°C during winter. The average annual rainfall varies from 200 mm to 1270 mm. This species is found in Dry Tropical Forests and Tropical Thorn Forests in India.

It grows quickly, coppices readily and is a source of fixing nitrogen thus improving the soil fertility. In dry areas it is browsed heavily by camel and goats. The timber is utilized for poles, and day to day needs of the rural society. It provides a gum which is edible. The tree provides shade and shelter and is excellent soil binder, which makes it useful in soil conservation work.

In view of its multiple uses, F.A.O. and the International Board for Plant Gene Resources (IBPGR) of the consultative group for International Agricultural Research has given priority to the exploration, collection and conservation of this species. (The other priority species for the arid zone are ***Acacia senegal, Prosopis cineraria, P. juliflora, Acacia tortilis*** etc.).

Varieties

Three varieties of ***A. nilotica*** are recognised to occur in India. ***A. nilotica*** var. ***jaquemontii*** with spreading crown, spines short and few, bark blackish brown relatively smooth. Pods are moniliform and thin. This variety is economically important and

extensively planted, and is common in the Indo-Gangetic basin. *A. nilotica* var. *vediana* as compared to var. *jaquemontii* is smaller with more spreading crown, bark greyish brown and rough. The spines are numberous, stouter and long. Pods are flat and little constricted between seeds. The wood is inferior and only fit for fuelwood. This variety is common in the Deccan.

A. nilotica var. *cupressiformis* (Ramkanta) can be easily distinguished by its broom like (Cuppressiform), ascending branches. This is found in Punjab, Uttar Pradesh, Rajasthan, Madhya Pradesh, Maharashtra and Gujarat. The variety is considered to be most suitable for planting on agriculture field bunds in Agro-forestry systems.

A. nilotica shows considerable variation because of its wide geographical distribution. Lot of variation exists in seed quality from one origin to another as regards morphological variation and physiological differences are concerned. Seeds from moist locality are generally bigger as compared to seeds from dry locality. It has been reported that in Sudan the phenological behaviour of *A nilotica* is influenced by rainfall, temperature and evaporation. Seeding is also influenced by evaporation (Waheed Khan, 1970). There is no comparative study of germination capacity of seeds of various Indian provenances of *A. nilotica* under Laboratory conditions is available. The information available consists mainly germination tests carried out under varying temperatures, varying moisture status, pretreatment and nursery practices.

Seed is the principal means for propagation of most trees. Importance of using healthy and high quality seed for plantation programme has been realized. Seed quality depends on many factors such as age and vigour of trees, root competition, crown exposure, fertility and moisture content of the soil, climatic variations, heredity, etc. Harvesting is very careful operation and requires a knowledge of seed ripening and dispersal characteristics. Viability of seed is much effected by its moisture content. Viability of seed declines with increasing moisture content and temperature.

In the case of *A. nilotica* ssp. *indica* twelve provenances of var. *jaquemontii*, three provenances of var. *cupressiformis* and three provenances of var. *vediana* have been identified. Seeds collected from various agencies were received at the Forest Research Institute, Dehra Dun during 1983. These seeds were screened, cleaned and stored for future work. Investigations on morphology, seed weight and seed viability were conducted. The ebjective of the study was to evaluate different varieties/provenances ef *Acacia nilotica* on the basis of seed quality. The results of this study conducted on germination behaviour of seeds of various provenances of *Acacia nilotica* are discussed in this paper.

Material and Methods

The study was conducted at Seed Testing Laboratory, Forest Research Institute, Dehra Dun during January–February, 1984. The study had 18 treatments of *Acacia*

nilotica ssp. *indica* comprising of 12 provenances of var. *jaquemontii*, three provenances of var. *cupressiformis* and three provenances of var. *vediana* as per details given in Table 1.

Table 1

Details of varieties and provenances of Acacia nilotica ssp. indica.

Sl. No.	Species/ varieties	Origin	Description of locality		Mean Annual Rainfall (mm)	elevation (m)
			Lat.	Long.		
1	2	3	4	5	6	7
1.	*A. nilotica* ssp. *indica* var. *jaquemontii*	Hyderabad Zone, (Andhra Pradesh)	17°-27′ N	78°-28′ E	764	545
2.	—do—	Nizamabad, Adilabad, (Andhra Pradesh)	18°-40′ N	78°-06′ E	1086	181
3.	-do -	Sabarkantha, Banaskantha (Gujarat)	24°N-	71°-30′ E	279	179
4.	—do—	Dharwar Gadag (Karnataka)	15°-25′ N	75°-38′ E	664	660
5.	—do—	Kurukshetra (Haryana)	29°-57′ N	76°-27′ E	958	240
6.	—do—	Rohtak (Haryana)	29°-20′ N	76°-03′ E	500	240
7.	—do—	Sriganganagar (Rajasthan)	30°-05′ N	74°-45′ E	254	190
8.	—do—	Madurai (Tamil Nadu)	—	—	—	—

(Contd..)

1	2	3	4	5	6	7
9.	—do—	Paratwara (Maharashtra)	20°–56′ N	77°–47′ E	975	370
10.	—do—	Fazilka (Punjab)	30°–15′ N	74°-10′ E	537	200
11.	—do—	Akola (Maharashtra)	20°–42′ N	77°–02′ E	877	282
12.	—do—	Jullundhar (Punjab)	—	—	—	—
13.	***A. nilotica*** **ssp.** ***indica*** **var** ***cupressiformis***	Pune (Maharashtra)	18°–32′ N	70°–51′ E	715	559
14.	—do—	Dhond (Maharashtra)	18°–32′ N	73°–51′ E	463	559
15.	—do—	Akola (Maharashtra)	20°–42′ N	77°–02′ E	877	282
16.	***A. nilotica*** **ssp.** ***indica*** **var.** ***vediana.***	Vrindavan (Uttar Pradesh)	—	—	—	—
17.	—do—	Pune (Maharashtra)	18°–23′ N	74°–30′ E	463	1823
18.	—do—	Paratwara (Maharashtra)	20°–56′ N	77°–47′ E	975	370

Seed Morphology

Seeds of *Acacia* species generally vary in morphological characters. To distinguish one variety from another variety and one provenance to another provenance under the same variety, studies were conducted on external features such as weight, size, moisture per cent, colour of seeds, shape and other seed surface characters. The observations so recorded are presented in Table 2.

Table 2

Effect of seed sources on seed morphology

Sl. No.	Provenance	No. of seeds/kg	Seed size (cm)			Volume of 100 seeds (cc.)	Moisture per cent	Seed colour	Identification clues
			Length	width	thick-ness				
1	2	3	4	5	6	7	8	9	10
1.	T_1	6600	0.82	0.67	0.37	9.626	8.8	Very dusky red.	Seeds more or less ovate area within the ring slightly flattened. Ring light yellowish brown.
2.	T_2	7057	0.76	0.65	0.39	9.626	8.1	Dark reddish brown	Seeds ovoid to broadly elleptic, area within the ring slightly flattened, ring light yellowish brown.
3.	T_3	6435	0.77	0.67	0.47	10.00	5.3	Dusky red	Seed more or less ovoid, area within the ring slightly flattened. Ring pale brown.
4.	T_4	7402	0.71	0.58	0.41	9.126	5.4	Dark reddish brown	Seeds ovoid to broadly eliptic, ring very pale brown.

(*Contd*...)

1	2	3	4	5	6	7	8	9	10
5.	T_5	7402	0.72	0.61	0.37	9.876	10.8	Very dusky red	Seeds more or less circular, ring pale brown.
6.	T_6	7794	0.63	0.59	0.34	9.626	8.6	Very dusky red.	Seeds more or less circular, ring light gray.
7.	T_7	6600	0.76	0.65	0.39	10.750	8.8	Dusky red	Seeds more or less ovoid, area within the ring slightly flattened, ring very pale brown, often incomplete.
8.	T_8	7321	0.77	0.60	0.38	8.876	7.1	Dark reddish brown	Seeds diverse in shape circular to ovoid, ring light gray to pale brown.
9.	T_9	6305	0.83	0.65	0.40	10.250	10.4	Dark reddish brown	Seeds broadly ovate often oblong, ring light gray to pale brown.
10.	T_{10}	8865	0.69	0.58	0.33	7.876	8.2	Dusky red	Seeds more or less ovoid ring light gray to pale brown.
11.	T_{11}	7262	0.78	0.67	0.44	9.750	8.3	Dusky red	Seeds diverse in shape mostly broadly elliptic, area within the ring slightly flattened, ring light gray to pale brown.

(*Contd*...)

1	2	3	4	5	6	7	8	9	10
12.	T_{12}	7587	0.76	0.62	0.35	9.376	13.0	Very dusky red	Seeds more or less ovate often rectangular, ring light gray often incomplete.
13.	T_{13}	6649	0.76	0.60	0.38	10.626	9.9	Dusky red	Seeds more or less ovoid, ring light gray, area within the ring slightly flattened.
14.	T_{14}	7692	0.73	0.64	0.46	8.876	8.1	Dark reddish brown	Seeds circular to broadly elliptic, ring light grey to pale brown.
15.	T_{15}	6998	0.79	0.69	0.47	10.250	7.5	Very dark gray	Seeds circular to broadly elliptic, ring dark gray.
16.	T_{16}	6988	0,77	0.65	0.42	9.750	8.5	Dusky red	Seeds more or less ovoid, ring light gray to pale brown, area within the ring slightly flattended.
17.	T_{17}	7241	0.71	0.59	0.39	8.750	6.3	Very dusky red	Seeds circular to broadly elliptic, ring light gray to pale brown.
18.	T_{18}	7262	0.69	0.56	0.41	9,000	7.6	Reddish black	Seeds circular to broadly elliptic ring light gray to pale brown.

Studies on Genus *Acacia* have been done by number of workers (Boelcke, 1946; Vassal, 1963, 1971; Gopal and Thapliyal, 1971). It can be seen from Table 2 that considerable variation in morphological characters exists within the varieties and also within the provenances. Seed colour and seed identification clues were studied for all varieties/provenances and have been presented in Table 2. These characters will be helpful for the seed collector while making collections.

From the seed weight data it can be seen that there is considerable variation. Number of seeds per kg varies from 6305 to 8865. Maximum number of seeds i.e., 8865 were found in provenance Fazilka (T_{10}). The seed length amongst various provenances varies from 0 63 cm to 0.83 cm, seed width from 0.56 cm to 0.69 cm and seed thickness ftom 0.33 cm to 0.47 cm. Among the provenances of var. *jaquemontii*, variation of 2 mm was found in seed length while in case of var. *cupressiformis* and var. *vediana*, this variation was only 0.6 mm and 0.8 mm respectively. There wes no marked difference available in seed width. The difference in seed thickness of *A. nilotica* var. *vediana*, was very less as compared to other two varieties.

A critical review of the seed size reveals that length, width and thickness was found to be the lowest (0.69 cm, 0.58 cm and 0.33 cm respectively) for the provenance of Fazilka (T_{10}) of *A. nilotica* var *jaquemontii*. On the basis of seed weight and seed size, seeds of this variety can thus be considered to be the smallest as compared to other varieties/provenances. The seeds having moisture content below 8 per cent gave significantly lower germination per cent which clearly demonstrated the damaging effect on seed viability.

Acacia nilotica bears fruit and produces an abundant crop of pods almost every year. Ripe pods are usually blown from the trees by wind and are collected from the ground under the trees. Pods are also collected by beating off the branches with a stick. After collection, pods are spread in the sun for drying. Seed is extracted from the dried pods by beating with sticks. Seed form about 40 per cent of the weight of the pods. Seed retain viability for many years. Tests carried out at Forest Research Institute, Dehra Dun reveals that after proper storage for three years, there was no fall in the germinative capacity.

Germination trials

400 seeds of each variety/provenance of *A. nilotica* were sown in lots of 100 seeds using randomised block design with four replications. The seeds were sown between germination paper as per ISTA rules 1976. Two sets of experiments were set up using treated and untreated seeds. Pretreatment to seeds is essential to hasten the germination of the seeds. The seeds were dipped in hot (80°C) water for ten minutes and then soaking the seeds in ordinary water for 24 hours. The experiment was conducted in the germination room maintained at 30°C (± 2). Watering to seeds was done delay

and count of germinated seed was recorded every day till final count. Number of hard seeds were counted at the time of final count and per cent was also calculated. At the end of the study, 25 seedlings were taken out at random from each replications taking care that the whole root systems came out intact. Observations on length of roots and shoots were recorded. In case of provenances where the germination per cent was poor, all the germinated seedlings were used for the above study.

Progress of germination. To get an idea as to how the germination was progressed with time under various treatments (provenances), observations on time to reach 50 per cent were recorded. The total germination per cent was also calculated at the end of each week upto the final count or 4 weeks whichever was earlier. Germination rate index was then calculated by taking mean of upto four values (weekly) as applicable of germination per cent. The data for days elapsed for 50 per cent germination and index for germination rate are presented in Table 3.

Table 3

Effect of seed source and pretreatment to seeds on time to reach 50 per cent germination and germination rate.

Treatment	Time for 50 per cent germination days elapsed from date sown		Germination rate Index (As per week for upto 4 weeks)	
	Untreated	Treated	Untreated	Treated
T_1	<50%	Day 11	27.6	64.0
T_2	<50%	Day 24	16.0	48.9
T_3	<50%	Day 27	5.8	31.6
T_4	<50%	<50%	9.3	16.8
T_5	Day 10	Day 11	49.4	64.9
T_6	<50%	Day 14	22.9	58.4
T_7	Day 9	Day 11	62.6	63.4
T_8	<50%	Day 27	12.0	30.5
T_9	Day 15	Day 8	43.1	75.9
T_{10}	Day 20	Day 8	45.3	80.1
T_{11}	<50%	Day 13	27.1	58.4
T_{12}	Day 26	Day 15	40.0	51.5
T_{13}	Day 10	Day 11	49.9	58.5
T_{14}	<50%	Day 27	3.8	33.3
T_{15}	<50%	Day 22	26.0	42.1
T_{16}	Day 10	Day 11	55.0	64.6
T_{17}	<50%	<50%	12.5	29.4
T_{18}	<50%	<50%	18.9	32.0

Note :—Sign < indicates that the germination per cent remained below 50 per cent till final count.

It can be seen from Table 3 that seeds treated with hot water gave quicker germination than untreated seeds. In case of pretreated seeds nearly all the provenances reached above 50 per cent germination except provenance 4, 17 and 18. Seeds collected from provenance Paratwara (T_9) and provenance Fazilka (T_{10}) reached 50 per cent germination on 8th day while provenances 1, 5, 7, 13 and 16 took 11 days. Rest of provenances took 13 to 27 days.

The data in Table 3 show that the germination rate for provenance Paratwara (T_9) and provenance Fazilka (T_{10}) was also highest followed by treatments 5, 16, 1, 7, 13, 6, 11 and 12. The other provenance gave poor index of germination rate.

Germination behaviour. The experiment was terminated on the 28th day. To ascertain the effectiveness of the seed treatment and seed sources (provenances) in terms of changes in the germination behaviour and to determine the germination value, the final seedling count was considered. Data on total germination per cent and per cent of hard seeds as calculated at the end of final count is given in Table 4. Germination value (GV) is a product of peak value of germination (PV) and mean daily germination (MDG); i.e., $GV = PV \times MDG$ (Czabator, 1962). The germination value so calculated is also presented in Table 4.

Seeds most of the tropical leguminous tree species are dormant due to impermeability of seed coat. The pretreatments given for breaking dormancy includes soaking the seeds in cold or hot water, treating with acids, inorganic or organic salts. Investigations carried out at the Forest Research Institute, Dehra Dun indicate that steeping of seeds in hot water for 5 minutes is sufficient to break the dormancy of *Acacia mearnsii* and *A. melanoxylon*. In a separate study it was reported that maximum germination of *Acacia tortilis* seeds can be obtained by treating with H_2SO_4, while in case of *Albizia lebbeck*, 80 per cent germination can be obtained by mechanical scarification.

From the results presented in this paper it is clear that pretreatment given to *A. nilotica* seeds gave distinctly better and quicker germination as compared to untreated seeds.

To assess the suitability of various treatments (provenances), the data on germination per cent was analysed for both pretreated and untreated seeds. It was found that various treatments (provenances) had significant difference at 0.1 per cent level of probability among themselves. The results of treated seeds have been discussed here. It is concluded that provenance Fazilka (T_{10}) gave highest germination per cent followed by provenance Paratwara (T_9) provenanc Rohtak (T_6) and Kurukshatra (T_5) but there was no significant difference among them. Among the remaining provenances the germination per cent of provenances (T_7, T_1, T_{16}, T_{11}, T_{13} and T_{12}) was significantly greater i.e., above 50 per cent than other provenances i.e., T_2, T_3, T_{15}, T_{14}, T_8, T_{17}, T_{18} and T_4.

Table 4

Effect of various seed sources on germination per cent, germination value and root and shoot length.

Provenance	Germination per cent		Per cent of Hard Seeds		Germination value		Average length (cm) Treated	
	Untreated	Treated	Untreated	Treated	Untreated	Treated	Root	Shoot
T_1	36.84	61.73	62	16	3.25	14.98	6.64	6.94
T_2	26.80	48.46	76	26	1.14	5.96	6.05	5.24
T_3	16.43	47.30	86	44	0.16	3.97	8.50	5.25
T_4	21.81	29.43	70	54	0.38	1.23	5.75	5.56
T_5	51.97	68.19	34	2	12.39	16.18	7.56	6.60
T_6	34.73	68.23	64	4	2.20	13.14	5.82	4,90
T_7	61.02	62.11	20	2	19.27	13.62	8.12	8,38
T_8	23.79	45.00	66	28	0.68	3.30	6.10	5.20
T_9	46.15	71.75	44	6	9.20	21.02	8.58	6.30
T_{10}	45.29	72.17	46	2	8.84	23.56	8.66	8.78
T_{11}	32.91	59.64	58	16	3.07	12.39	8.36	8.40
T_{12}	45.02	56.20	16	0	6.38	8.68	5.64	5.54
T_{13}	51.96	58.79	36	2	13.23	12.63	7.16	5.86
T_{14}	14.08	45.86	76	32	0.06	4.14	6.04	5.48
T_{15}	35.01	46.72	50	34	3.30	6.43	7.62	7.16
T_{16}	55.46	61,14	24	0	3.24	15.42	7.56	5.78
T_{17}	24.65	38.93	72	58	0.66	3.02	5.63	5.72
T_{18}	29.52	38.22	68	56	1.69	3.49	6.50	6.34

Following Bar Diagrams for Treated Seeds were obtained

T_{10}	T_9	T_6	T_5
72.17	71.75	68.23	68.19

T_7	T_1	T_{16}	T_{11}	T_{13}	T_{12}
62.11	61.73	61.14	59.64	58.79	56.20

T_2	T_3	T_{15}	T_{14}	T_8
48.46	47.30	46.72	45.86	45.00

T_{17}	T_{18}	T_4
38.93	38.22	29.43

A look at the germination per cent of various varieties/provenances given in Table 4 would show that var. *jaquemontii* exhibited better germination per cent as compared to var. *cupressiformis* and var. *vediana* and among the different provenances of var. *jaquemontii*, provenances Fazilka, Paratwara, Rohtak and Kurukshetra have proved best as compared to other provenances.

It can be seen from the data on germination value for pretreated seeds presented in Table 4 that provenances, Fazilka (T_{10}) and Paratwara (T_9) of var. *jaquemontii* gave the highest germination value as compared to other provenances.

A perusal of the data on shoot length would show that practically there is no effect on shoot length of the seedlings except in the case of provenances Fazilka (T_{10}), Akola (T_{11}) and Ganganagar (T_7) of var. *jaquemontii* where the shoot length was found to be somewhat longer. So far as the root length is concerned, provenances Fazilka (T_{10}), Peratwara (T_9), Sabarkantha (T_8), Akola (T_{11}) and Ganganagar (T_7) of var. *jaquemontii* gave somewhat higher shoot length.

Conclusion

Looking to all the parameters in Table 4, it can thus be concluded that a seed of var. *jaquemontii*, from the provenances of Fazilka (T_{10}) has ranked higher followed by Paratwara (T_9), Rohtak (T_6) and Kurukshetra (T_5).

Acknowledgement

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SUMMARY

A study based on 18 treatments comprising 12 provenauces of *A. nilotica* var. *jaquemontii*, three provenances of var. *cupressiformis* and three provenances of var. *vediana* was conducted during January-February, 1984 at Seed Testing Laboratory, Forest Research Institute, Dehra Dun. The morphological variations and physiological differences and their effect on germination behaviour of seeds of different varieties/provenances of *A. nilotica* have been recorded and requirement of pretreatment to hasten the germination have been prescribed. Hard seed coat of *A. nilotica* retards germination and treatment with hot water gives the best results. The results of the study indicate that out of the various provenances of *A. nilotica* var *jaquemontii*, Fazilka, Paratwara, Rohtak and Kurukshetra provenances have proved to be the best.

अकेसिया नीलोटिका उपजा० इण्डिका के विभिन्न स्थानज विभेदों का अंकुरण व्यवहार

लेखक आर०एस० माथुर, के०के० शर्मा व एम०एम०एस० रावत

सारांश

वन अनुसंधान संस्थान, देहरादून की बीज परीक्षण प्रयोगशाला में जनवरी–फरवरी 1984 के दौरान अकेसिया नीलोटिका विभेद जैकमोंटिआई के बारह, उसी के विभेद क्युप्रेसिफार्मिस के तीन तथा उसी के विभेद वेदियाना के तीन स्थानज विभेदों पर किये गये अठारह उपचारों पर आधारित एक अध्ययन सम्पन्न किया गया। रचनाकारिकीय अन्तर तथा देह-व्यापारिकीय भिन्नता तथा अ० नीलोटिका के विभिन्न विभेदों/स्थानज भेदों के अंकुरण पर उनका प्रभाव आलेखित किया गया तथा अंकुरण में तेजी लाने के लिए पूर्वोपचारों की आवश्यकता निर्धारित की गई अ० नीलोटिका का कडा बीज-चोल अंकुरण में विलम्ब करता है और उसे गर्म पानी में भिगोने के उपचार से सर्वोतम परिणाम निकलते हैं। इस अध्ययन के परिणामों से यह संकेत, मिलता है कि अ० नीलोटिका के विभिन्न स्थानज भेदों में से उसके जैकमोंटिआई विभेद के फाजिल्का, परतवाड़ा, रोहतक और कुरुक्षेत्र के स्थानज भेद सर्वोत्तम रहे हैं।

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MANAGEMENT OF SPRUCE AND SILVER FIR FORESTS FOR PACKING BOXES SUPPLY IN HIMACHAL PRADESH

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Introduction

Growing of temperate fruits in Himachal Pradesh is more paying than conventional agriculture. As a result, the area under temperate fruits has steadily increased during the last two decades from about 4,000 hectares in 1960 to about 64,000 hectares in 1981. The area of temperate fruits is, however, not uniformly distributed throughout the temperate zone of the state and is mostly concentrated in Simla, Kulu and Mandi districts. Table 1 summarizes the area under temperate fruits in different districts of the state.

Table 1

*Area under temperate fruits in different districts during 1981-82**

District	Area in hectares under		
	Apple	Other temperate fruits	Total
Simla	19,422	2,552	21,974
Mandi	7,106	3,072	10,178
Chamba	1,854	790	2,644
Bilaspur	25	407	432
Kinnaur	2,203	284	2,487
Solan	490	4,105	4,595
Sirmur	3,005	1,978	4,983
Kulu	10,767	2,375	13,142
Kangra	436	3,398	3,834
Una	—	237	237
Hamirpur	—	155	155
Lahaul and Spiti	52	33	85
Total	45,360	19,386	64,746

*Source H.P. Horticulture Department

The temperate fruits are packed in wooden boxes for transport to the market. Packing boxes used vary in size according to the quantity of fruits packed which in case of apple varies from 5 to 20 kg (ISI, 1966; Singh, 1971). Out of the coniferous species growing in areas of temperate fruits production, spruce and silver fir are the main species used for packing boxes manufacture. Beside spruce and silver fir, other species used, though in small quantities, are chir pine, blue pine and some broadleaved species. Spruce and silver fir constitute (on the basis of last six years average) 94.62 per cent of the total volume of wood used for packing boxes manufacture. As the area under temperate fruits increases further and as the young orchards start bearing, the volume of wood of spruce and silver fir needed for the manufacture of packing boxes will consequently increase. This paper discusses the impact of packing boxes supply on the management of spruce and silver fir forests.

Management of Spruce and Silver Fir Forests for Packing Boxes Supply

The spruce and silver fir forests were not considered of much economic value before Second World War (Singh, 1975) after which their wood came in demand for railway sleepers, constructional timber and packaging. The demand for the manufacture of packing boxes for temperate fruits being very small two decades ago, the management practices prescribed in the working plans for these forests did not take into account this demend. It was only in Kotgarh Forest Division that this demand was taken into consideration at the time of working plan preparation and a separate felling series was provided for the purpose, In other working plans no separate felling series for this purpose have been formed and no separate allocation of forest areas for meeting this demand has been made. The demand for spruce and silver fir wood for the manufacture of packing boxes in some of the forest divisions at present is fairly sizeable. As this demand is required to be met from accessible forests of spruce and silver fir along the roads to facilitate extraction, the non-provision of a separate felling series for this purpose is resulting in over-exploitation of more accessible forests along the roads. Constitution of separate felling series in the working plan for meeting this demand is necessitated.

The silvicultural system followed for spruce and silver fir forests being worked for the supply of wood for packing boxes in Uniform Shelterwood system although some trees for the purpose are extracted in thinnings also. In many areas the marking ef trees is not strictly according to the silvicultural principles because of the demand of the saw-millers for trees of only specific dimensions. In such cases selective fellings is the result. Table 3 summarizes the number of spruce and silver fir trees and Table 4 the volume of the same marked in different diameter classes, viz.: V (10 — <20 cm), IV (20 — <30 cm), III (30 — <40 cm), II A (40 — <50 cm),

II B (50 — <60 cm), I A (60 — <10 cm), I B (70 — <80 cm), I C (80 — <90 cm), I D (90 — <100 cm) and I E (100 cm and above) during 1981 in different forest divisions for the manufacture of wooden packing baxes.

By number of trees, IA and below diameter class trees constituted for the main bulk (72.35 per cent) while by volume IA and over diameter class trees accounted for the main bulk (74.90 per cent) of the total trees marked for packing boxes manufacture in 1981.

Marking of the trees as near to a saw mill as possible necessitates having small annual coupes and spreading of harvesting operations in the greater part of a particular forest division. Consequently. small areas worked are not planted soon after felling. Planting is delayed till the whole forest compartment has been worked. This delay in planting results in the invasion of the felled areas by noxious weeds and bushes which renders planting of such areas difficult and costly if not impossible.

Raising of nursery stock of spruce and silver fir takes about 3 to 5 years respectively and sufficient nursery stock is not always available for planting the areas felled. The area of spruce and silver fir forests felled for the supply of about 1 lac m^3 of wood for packing cases annually works out to about 540 ha (average growing stock 275 m^3/ha and 60% of the same to be felled in seeding felling). The area sown/ planted annually is about 300 ha (Annon., 1980). As a consequence several forests of spruce and silver fir covering large areas have not been regenerated and are full of bushes and weeds; the area of such unregenerated forests will continue increasing in future till measures to raise sufficient planting stock and to plant such areas in time are taken.

Felling of Trees and Conversions into Billets

The trees sold to the saw-millers are felled and converted into billets by *nepali* labour as hardly any local labour is available for the purpose in view of alternative, less arduous and more remunerative works of plucking and packing of fruits available to the local people in their own or nearby villages. The *nepali* labourers are engaged on contract basis and are paid on the basis of the billets delivered on the roadside or at the saw-mill. The saw-millers, who invariably own orchards, find no time to supervise extraction of wood in the forest and leave it entirely to the labourers engaged for the purpose. *Nepali* labourers engaged for the extraction of wood are mostly untrained; interrogation of some of them revealed that they had no experience of forest harvesting operations and whatever wood-cutting they have ever done in their homeland is the hacking of trees for firewood collection. They are paid for the number of billets extracted and are neither penalised for wastage nor rewarded for higher recovery in wood harvesting. Added to this untrained labour disinterested in optimum wood utilization is the indifference of saw-millers to wood harvesting who do not bother about the wastage of wood in extraction in view of very

Table 3

Trees of spruce and silver fir marked for the manufacture of packing boxes during 1981 in some forest divisions

Forest Division	Number of trees of different diameter classes										
	V	IV	III	II A	II B	I A	I B	I C	I D	I E	Total
Simla	31	762	2939	3594	2540	1227	518	138	37	31	11817
Kotgarh	6	487	1352	2384	2725	2233	1595	1097	1616	26	13521
Rohru	—	34	575	1302	1668	1681	1209	727	835	462	8493
Chopal	33	82	62	82	78	66	25	15	36	—	479
Kulu	—	76	278	418	652	787	623	523	1395	—	4752
Seraj	—	1	193	358	326	259	119	77	83	—	1416
Total	70	1442	5399	8138	7989	6253	4089	2577	4002	519	40478
Percentage of total trees marked	.17	3.57	13.34	20.10	19.73	15.44	10.10	6.38	9.88	1.29	100.00

Table 4

Volume of spruce and silver fir trees marked for the manufacture of packing boxes during 1981 in some forest divisions

Forest Divisicn	Volume (m^3) of trees of different diameter classes										
	V	IV	III	II A	II B	I A	I B	I C	I D	I E	Total
Simla	1.86	228.6	2351.2	6109.8	7874.0	6257.7	3677.8	1173.0	344.1	310.0	28328.06
Kotgarh	0.3	146.1	1216.8	4052.8	8447.5	10718.4	10048.5	9653.6	17452.8	280.0	62017.60
Rohru	—	10.40	409.78	2069.68	4940.46	8997.84	8825.70	6902.0	8477.32	5135.75	45768 93
Chopal	1.98	22.96	61.38	150.88	242.58	317.46	162.75	127.35	356.76	—	1444.10
Kulu	—	10.64	236.30	710.60	2027.72	4013.70	4410.84	4445.50	13029.30	—	28884.60
Seraj	—	0.14	164.05	608.6	1013.86	1320.9	842.52	653.73	775 22	—	5379.02
Total	4.14	418.84	4439.51	13702.36	24546.12	31626.0	27968.11	22955.18	40435.5	5726.55	171822.21
Percentage of total volume	0.002	.24	2.95	7.99	14.28	18.40	16.28	13.35	23.54	3.33	100.00

cheap rates at which they are sold the trees; the price of trees is a minor component (not more than about one third) in the total cost of production of the packing boxes. The result is the cutting of trees, their billeting and transport of billets to the roadside in a very inefficient way.

The trees are invariably out by axe, which is a very wastefull method leaving very high stumps; measurement of stumps in some of the forests of Kotgarh Forest Division worked for extraction of wood for packing boxes gave the stump height as 81.47 ± 12.74 cm. The wastage in axe cutting and as a result of unnecessary high stumps (after leaving 15 cm permissible stump height) increases with an increase in the diameter of trees and the same for different diameter classes is summarized in Table 5 (Singh, 1982).

Table 5

Wastage of wood due to high stump and cutting by axe

Diameter class (cm)	Wastage of wood (m^3) due to		
	Stump height	Cutting by axe	Total
20-30	0.017	0.008	0.025
30-40	0.035	0.018	0.053
40-50	0.063	0.030	0.093
50-60	0.116	0.047	0.163
60-70	0.185	0.065	0.250
70-80	0.260	0.115	0.375
80-90	0.352	0.172	0.524

The billets are rolled down the hill slopes and this practice disturbs the humus and the soil and leads to soil erosion. In some areas worked, the humus has been washed and serious erosion has started. The depression and small streams are used for rolling of the billets which causes serious soil erosion and as a result the streams and gullies have widened appreciably during the last few years only.

The rolling of billets does not only lead to serious soil erosion in these areas but also damages the standing trees. The rolling billets on slopes in the forest gain high speed and strike against the standing trees with great force. As a result, the bark and in some cases the sapewood are peeled off. Rot starts in such damaged trees. It is feared that most of such damaged trees wlll develop rot in their basal portion which constitutes the most valuable portion for timber production; rot has already set in the basal portion

of trees damaged a few years ago. A survey conducted in one of the forests worked in 1981 wherefrom 611 trees of spruce and silver fir were extracted for packing boxes manufacture showed that 309 trees of spruce and silver fir were damaged and are likely to develop rot in the basal portion.

The regeneration present on the forest floor is also destroyed by rolling of the billets. This aspect assumes importance in view of the fact that obtaining and establishing the regeneration of spruce and silver fir is a serious problem (Singh, 1975).

Wastage of Valuable Wood in Packing Boxes Manufacture

Cutting and billetting of the trees and sawing the billets into planks for the manufacture of packing boxes results in appreciable wastage of the valuable wood as evidenced by Table 6 (Singh, 1982).

Table 6

Wastage in harvesting of trees and manufacture of wooden boxes

Mean tree dbh (cm)	Wastage (percentage) to total tree volume in			
	High stump and felling by axe	Rejection of top portion	Sawing	Total
25	6.07	24.51	39.47	70.05
35	5.29	6.93	46.21	58.43
45	4.75	2.81	45.90	53.46
55	4.78	1.38	45.41	51.57
65	5.51	0.91	46.09	52.51
75	5.74	0.51	50.33	56.58
85	6.18	0.36	55.56	62.10
95	5.92	0.25	65.02	71.19

More than 50 per cent of the tree volume is wasted in the process of the manufacture of packing boxes. Bigger diameter class trees (bigger than IA) in whose case the wastage is still more account for about 75 per cent of the total volume of spruce and silver fir marked for the manufacture of wooden boxes (Table 4). Thus a greater part of the tree volume is wasted. The wastage in cutting can be avoided by cutting the trees as low as possible with saw. Manufacture of packing cases out of veneers as demonstrated by Forest Research Institute will considerably reduce the wastage in sawing. Present method of harvesting the trees and of the manufacture of packing cases need be replaced by more efficient methods to avoid the wastage of valuable wood.

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GROWTH ANALYSIS OF CHIR (*PINUS ROXBURGHII*, SARGENT) PLANTATIONS IN SUPKHAR OF BALAGHAT DIVISION OF MADHYA PRADESH

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Introduction

The natural habitat of Chir pine is throughout the whole length of the Western and Central Himalayas from North-West Frontier to Sikkim and West Bhutan, between 1000 m and 1800 m elevation above m.s.l., extending on ridges down to 600 m and upto 2300 m on the Southern exposures. It also occurs on Siwalik hills in the transition zone, mixed with ***Shorea robusta*** and its associates, in various proportion. It is a species of sub-tropical region and does not occur naturally in the tropical zone.

Madhya Pradesh lies on the tropical region and has tropical vegetation consisting of Sal (***Shorea robusta***), Teak (***Tectona grandis***), bamboos, and other broad leaved species, but no conifers. While managing the Sal forests of Balaghat Division of Madhya Pradesh, it was observed that due to frosty locality, the Sal seedlings in grassy blanks were dying every year and were not able to grow to the pole stage inspite of repeated cutting back. The blanks were extending eyery year and baffling the foresters. With a view to solve this problem, it was decided to plant Chir pine in these grassy blanks to act as a nurse crop to the struggling and bushy Sal seedlings. Thus, the Chir pine seeds were obtained from U.P. (Chakrata origin). The Ramgarh plateau near Supkhar village in Balaghat Divison, which was a gently sloping grassy blank was selected for raising Chir plantations. All the growth on the area was uprooted, land was ploughed about 15 cm deep and Chir seeds were broad cast sown in July, 1907. Thus, the chir established its home, outside its natural habitat in the tropical region for the first time in Supkhar of Madhya Pradesh. Thereafter, regular plantations of chir were continued and in the first series upto 1917, about 5 hectares were planted,

Although Chir plantations in Supkhar were raised originally with the main object of providing a nurse crop for the struggling Sal seedlings, but this object was lost sight of and it ended with the fine Chir plantations, which were growing faster than even All India Site quality I. In 1924, the sample plots were laid out in these plantations and their periodic measurements were recorded. The growth and yield data of these sample plots have been analysed by the author and the results are presented and discussed in this paper.

Site Features of the Study Area

Supkhar is in Balaghat district of Madhya Pradesh and is about 250 kms from Jabalpur towards South-West. It is situated at the latitude 22°3′N and longitude 81°E. Its elevation above mean sea level is 762 metre. The climate is tropical with maximum shade temperature of 95° F. Frequent frosts occur in winter. Average annual rainfall is about 1550 mm, bulk of which is received from July through September. Soil is sandy loam over laterite. The area is agently sloping plain surrounded by Sal forests of Q. III & IV. According to Champion & Seth (1968), the forest type is moist pennisular Sal forest (3c/C_2e).

Objects of the Study

The main objects of the present study are to :

(i) Determine the All India Site quality of Supkhar Chir pine plantations.

(ii) Analyse the growth rate of height, diameter, basal area and volume/hectare of the plantations.

(iii) Analyse the current and mean annual volume increments at various ages and thus find out the rotation age of maximum volume production.

(iv) Compare the mean annual and current annual increments of Chir plantation viz.-a-viz. sal and teak.

Material and Method

In 1924, three Sample Plot No. 6, 7 and 8 were laid out in the Supkhar Chir plantations of 1907 and 1911 origin under the direction of the Central Silviculturist of Forest Research Institute, Dehra Dun. Their details are as given below :

Table 1

Showing the details of Supkhar Chir Sample Plots

Sample Plot No.	Year of plantation	Date of formation	Area in (ha)	Age (yrs.)	Remarks
6	1907	14.5.24	0.202	17	——
7	1907	14.5.24	0.023	17	Abandoned in 1930
8	1911	15.5.24	0.061	13	

On 14.12.1930, Sir H.G. Champion, the then Central Silviculturist of Forest Research Institute inspected these sample plots and opinioned that as the area of Sample Plot No. 7 is very small, it will not serve any purpose and as such should be closed.

Thus, the Sample Plot No. 7 was abandoned from 1930. Regular measurements of other two sample plots were recorded periodically. The last full measurements of these sample plots which were recorded in March/April 1967 are available. The growth and yield data of the Sample Plots No. 6 and 8 form the base material for the present study.

The growth and yield data of the Sample Plot No. 6 and 8 were analysed by the author. The top heights recorded at the various ages were plotted on an ordinary graph paper and smooth curves were drawn. Fig. 1 and 2 depict the site quality curves of Supkhar Chir plantations viz.-a-viz. All India Site qualities I and II of Chir yield tables (Seth *et al.*, 1972) for the Sample Plots 6 and 8 respectively. For other growth parameters, such as diameter, average height, basal area/ha. Volume/ha. etc., the measurements recorded and computed at various ages were also plotted on an ordinary graph paper at different ages and smooth curves were drawn. The various growth parameters at regular interval of 5 years were read off from the curves. Tables 2 and 3 give the growth and yield statistics of Sample Plot No. 6 and 8 respectively as obtained from data analysis and growth curves constructed. Computation for total yield, final yield, current annual increment and mean annual increment were also done and they are also presented in Tables 2 and 3 at the appropriate columns.

Results and Discussions

Site Quality : The study of Fig. 1 shows that in the Sample Plot No. 6, the top height of Supkhar chir exceeds the All India Site Q. I upto the age of 35 years, almost conforms to Q. I from 35 to 40 years and than lies between Q. I and Q. II, being more closer to Q. I. Almost the same trend is observed in Fig. 2 for the Sample Plot No. 8 with slight variation in the ages. Thus, the study reveals that in the early stages of growth of Chir pine in Supkhar, the Site quality is better than All India Site Q. I, but later on it approaches to Q. I. To be on the conservative side, the Site quality of Chir pine in Supkhar plantation may be considered as All India Q. I/II.

Growth. With a view to easily comprehend the growth pattern of Supkhar Chir plantation, a comparative statement showing the average diameter, average height, N/ha. and Vol./ha of the main crop and the total vol./ha, at various ages, for the Sample Plot No. 6 and 8 viz-a-viz yield table figures for Site Q. I/II has been constructed and is given in Table 4.

Table 4 shows that the rate of growth of diameter and height in Supkhar Chir is comparatively more than that of yield table figures. However, though the difference in the early years is large, but in the later ages the difference goes on reducing. The plausible reason for this may be that the yield tables are based on the chir crop of natural origin whereas Supkhar Chir is of plantation origin. This early trend of fast growth in diameter and height is also reflected in

the site quality curves in Fig. 1 and Fig. 2, wherein the site quality of Supkhar Chir surpasses the All India Site Q. I in the early years and lies between Q.I and Q. II in the later years. An interesting phenomenon is revealed by the close scrutiny of average diameters and average heights of Sample Plots No. 6 and 8. The growth of diameter and height in Sample Plot No. 6 is comparatively better than that of Sample Plot No. 8. The Sample Plot No. 6 was laid out at the age of 17 years while Sample Plot No. 8 was formed when the crop was 13 years old. Columns 8 and 9 of the Table 4 show that the number of trees/ha. in the Sample Plot No. 6 are always comparatively lower than those in Sample Plot No. 8, thereby revealing that the crop in Sample Plot No. 6 received comparatively heavier thinning than Sample Plot No. 8. The plausible reasons for this variation are that the crop in Sample Plot No. 8 started receiving pampering (tending) at the earlier age and was grown in congestion throughout, thereby it could not attain more height as it was not allowed to grow under stress; and it could not attain comparatively more diameter because it was always grown under stress. In the case of Sample Plot No.6, the crop was growing under stress upto the age of 17 years and as such it attained more height due to vertical competition. At 17 years, the crop was thinned and, thereafter, comparatively heavy thinning was always provided to it with the result that the diameter growth was faster. This points out to the fact that in the case of Chir plantation, the time of first thinning is probably, 17 years or so, by which time the maximum height is attained due to competetion for upward growing space. Once a better height is reached, then heavier thinnings are required for the better diameter growth.

Volume production

Columns 11, 12 and 13 of Table 4 give the comparative values of the Volume per hectare (stem timber and small wood) of the main crop at different ages. Stem timber volume is under bark upto 20 cms diameter limit while small wood volume is over bark upto 5 cm diameter limit. Small wood volume in the case of Sample Plot No. 6 and 8 consist of both stem portion and branches. As chir yield table (Seth *et al.*, 1972) do not give small wood volume of branches, the same could not be given in Col. 13. However, in the case of chir, the branches are few, so for the purpose of comparison this is not likely to matter much.

Scrutiny of columns 11, 12 and 13 of Table 4 show that the standing volume/ha of Supkhar chir is comparatively higher than yield table figures. Amongst Sample Plot No. 6 and Sample Plot 8, the standing Vol./ha of the former is consistently more than the later.

In Table 4, columns 14, 15 and 16 give the comparative growth of total volume production at various ages. It is evident that Supkhar chir gives by far the maximum total volume/ha at all ages as compared to the yield table figures for Site Q. I/II, so much so that the variation of ratio being 4 : 1 to 2 : 1. Amongst Sample Plot 6 and Sample Plot 8, the total volume/ha is always more in the former than the later.

Fig. 1

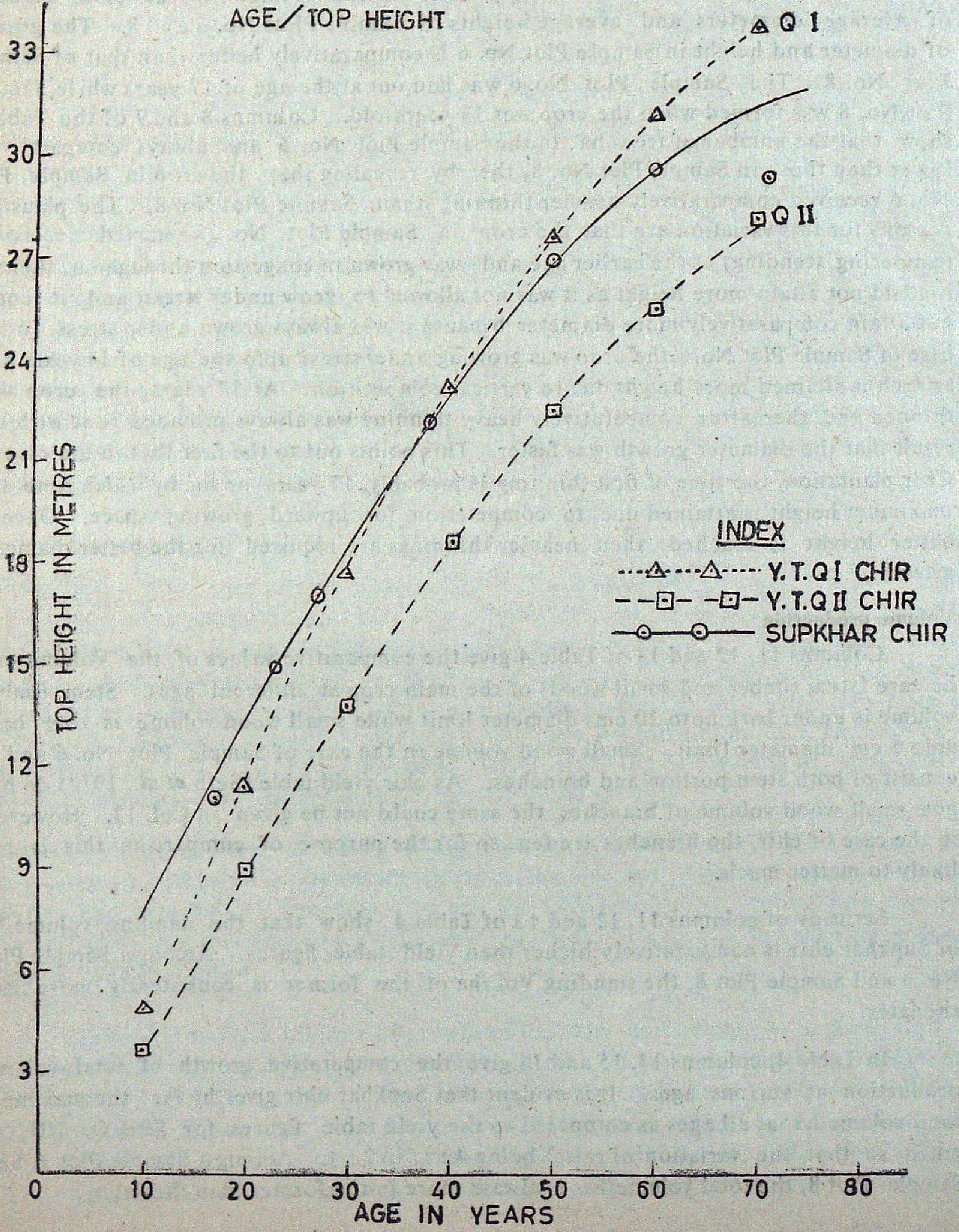
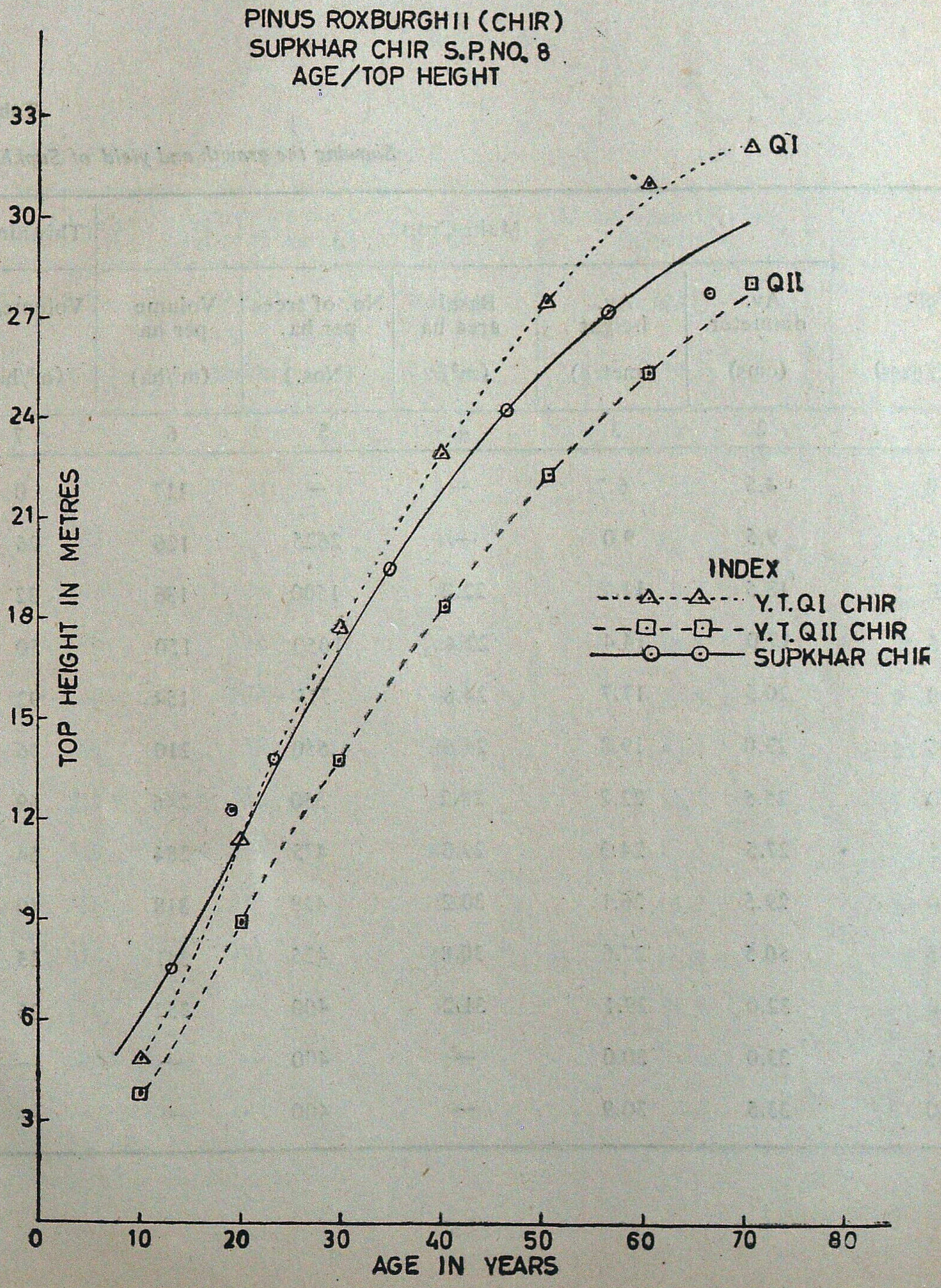

PINUS ROXBURGHII (CHIR)
SUPKHAR CHIR S.P. NO. 6
AGE/TOP HEIGHT
Q I
Q II
INDEX
Y. T. Q I CHIR
Y. T. Q II CHIR
SUPKHAR CHIR
TOP HEIGHT IN METRES
AGE IN YEARS
0
10
20
30
40
50
60
70
80
3
6
9
12
15
18
21
24
27
30
33

Fig. 2


PINUS ROXBURGHII (CHIR)
SUPKHAR CHIR S.P. NO. 8
AGE/TOP HEIGHT
TOP HEIGHT IN METRES
AGE IN YEARS
QI
QII
INDEX
Y.T.QI CHIR
Y.T.QII CHIR
SUPKHAR CHIR
0
10
20
30
40
50
60
70
80
3
6
9
12
15
18
21
24
27
30
33

Table

Showing the growth and yield of Supkhar

Age (Years)	Main Crop: Av. diameter (cms)	Av. height (metre)	Basal area ha (m²)	No. of trees per ha. (Nos.)	Volume per ha (m^3/ha)	Thinnings: Volume/ha. (m^3/ha)
1	2	3	4	5	6	7
10	4.5	6.7	—	—	117	0
15	9.5	9.0	—	2625	126	26
20	13.5	11.7	22.2	1500	136	32
25	17.0	14.4	22.4	1050	150	50
30	20.5	17.7	24.8	775	154	92
35	23.0	19.8	26.6	650	210	76
40	25.5	22.2	28.2	550	246	69
45	27.5	24.3	29.3	475	284	54
50	29.5	26.1	30.2	438	318	40
55	30.5	27.6	30.8	425	341	33
60	32.0	29.1	31.2	400	352	36
65	33.0	30.0	—	400	—	—
70	33.5	30.9	—	400	—	—

2

Chir plantation in Sample Plot No. 6

Final yeild	Accumulated yield of thinning	Total yield	Mean Annual/Volume increment	Current Annual Vol. increment
Vol./ha.	Vol./ha.	Vol./ha.	(MAI)	(CAI)
(m^3/ha)	(m^3/ha)	(m^3/ha)	(m^3/ha)	(m^3/ha)
8	9	10	11	12
117	0	117	11.7	7.0
152	26	152	10.1	8.4
168	58	194	9.7	12.8
200	108	258	10.3	19.2
246	200	354	11.8	26.4
286	276	486	13.8	21.0
315	345	591	14.7	18.4
338	399	683	15.2	14.8
358	439	757	15.1	11.2
374	472	813	14.8	9.0
386	508	858	14.3	8.6
395	—	—	—	—
—	—	—	—	—

Table

Showing the growth and yield of Supkhar

Age (Years)	Main Crop: Av. diameter (cms)	Av. height (meter)	Basal area per ha. (m^2/ha)	No. of trees per ha (Nos.)	Volume per ha (m^3/ha)	Thinnings: Vol./ha (m^3/ha)
1	2	3	4	5	6	7
10	4.8	4.2	—	—	86	20
15	8.5	7.2	27.0	—	106	40
20	12.5	10.5	22.8	1875	128	50
25	15.5	13.2	25.0	1325	150	54
30	18.5	15.9	26.4	950	172	52
35	21.0	18.0	27.5	750	192	50
40	23.5	20.1	27.8	600	210	44
45	25.0	21.6	27.8	525	226	40
50	26.2	23.1	27.5	475	239	37
55	27.0	24.3	26.7	450	252	32
60	27.5	25.5	—	425	262	26
65	28.0	26.1	—	425	270	—
70	28.0	27.0	—	425	—	—

3

Chir plantations in Sample Plot No. 8

Final yield Vol./ha (m^3/ha)	Accumulated yield of thinnings Vol./ha (m^3/ha)	Total yield Vol./ha (m^3/ha)	M.A.V.I. (m^3/ha)	C.A.V.I. (m^3/ha)
8	9	10	11	12
106	20	106	10.6	12.0
146	60	166	11.06	14.4
178	110	238	11.9	15.2
204	164	314	12.6	14.8
224	216	388	12.9	14.0
242	266	458	13.08	12.4
254	310	520	13.0	11.2
266	350	576	12.8	10.0
276	387	626	12.5	9.0
284	419	671	12.2	7.2
988	445	707	11.8	—
—	—	—	—	—
—	—	—	—	—

Table

Showing the Comparative growth of diameter, height, standing Volume/ha number of trees/ha

Gap Age in years	Main Crop						
	Av. diameter (cms)			Av. height (m)			Number of
	Sample Plot No. 6	S.P. No. 8	Yield Q. I/II Table	S.P. No. 6	S.P. No. 8	Y.T. Q. I/II	S.P. No. 6
1	2	3	4	5	6	7	8
15	9.5	8.5	10.2	9.0	7.2	4.9	2625
20	13.5	12.5	12.7	11.7	10.5	8.8	1500
25	17.0	15.5	15.0	14.4	13.2	12.2	1050
30	20.5	18.5	17.5	17.7	15.9	15.2	775
35	23.0	21.0	20.1	19.8	18.0	17.7	650
40	25.5	23.5	22.4	22.2	20.1	19.8	550
45	27.5	25.0	24.9	24.3	21.6	21.9	475
50	29.5	26.2	27.4	26.1	23.1	24.1	438
55	30.5	27.0	30.0	27.6	24.3	25.9	425
60	32.0	27.5	32.3	29.1	25.5	27.4	400
65	33.0	28.0	34.5	30.0	26.1	29.0	400
70	33.5	28.0	36.8	30.9	27.0	30.5	400

4

and total volume per ha of Sample Plots 6 and 8 vis-a-vis All India Site Q. I/II of Chir pine

Trees per hectare		Vol./ha (m^3) stem timber & small wood			Total volume Stem timber Small wood per hectare (m^3)		
S.P. No. 8	Y.T. Q. I/II	S.P. No. 6	S.P. No. 8	Y.T. Q. I/II	S.P. No. 6	S.P. No. 8	Y.T. Q.I/II
9	10	11	12	13	14	15	16
Many	2110	126	106	38.5	152	166	40.0
1875	1532	136	128	77.5	194	238	93.0
1325	1206	150	150	120.5	258	314	153.0
950	959	154	172	158.5	354	388	206.0
750	788	210	192	182.0	486	458	247.0
600	677	246	210	204.0	591	520	283.0
525	573	284	226	229.5	683	576	334.0
475	494	318	239	259.0	757	626	385.0
450	430	341	252	289.0	813	671	436.0
425	385	352	262	317.0	858	707	485.0
425	346	—	270	343.5	—	—	532.5
425	311	—	—	369.0	—	—	578.5

Increment

Mean annual volume increment (MAI) and the current annual volume increment (CAI) are the growth parameters which are of particular interest to the foresters. They help them in making the choice of species and also in determining the rotation age for maximum volume production. Thus, a comparative statement showing the mean annual volume increment and current annual volume increment for Supkhar Chir Sample Plots No. 6 and 8 viz.-a-viz. yield table figures for Q. I/II of Chir, Sal and Teak (Seth *et al*, 1972; Griffith *et al.*, 1943; Seth *et al.*, 1957) has been prepared and is presented in Table 5.

Columns 2, 3 and 4 of Table 5 clearly brings out the fact that MAVI of Supkhar Chir is consistently higher than that of yield table figure of Chir for Q. I/II. The growth of Supkhar Chir is also much more than Sal and Teak of Q. I/II which is evidenced from the yield table figures reproduced in columns 5 and 6 of the Table 5. Almost the same trend is depicted in the case of CAVI upto the age of about 50 years and thereafter Sal of Q. I/II takes a lead. However, considering the fact that the natural crop of Sal in the vicinity of Supkhar Chir plantation is of Q. III and Q. IV, it is imperative that the growth of Chir in this locality surpasses the Sal and Teak so far as the productivity of maximum volume production per hectare is concerned. More so, these plantations have been raised on the grassy blanks in this locality where even Sal is shy of growing due to frost. Thus, while making the choice of species for such areas, the Chir pine wins the race.

Rotation

With a view to determine the rotation age for the maximum volume production, the values of MAVI and CAVI of Sample Plots 6 and 8 from Table 5 were plotted against ages and smooth curves were drawn and are depicted in figures 3 and 4 respectively.

Fig. 3 shows that the MAI and CAI intersect at the ages 19 and 45 years whereas in Fig. 4, the point of intersection is at an age of 35 years. Ignoring the lower points of intersection due to insufficient data for the younger ages because the sample plots were formed at 17 and 13 years, the rotation of maximum volume production may be considered on the basis of the points of intersection at the later ages. Thus, the probable rotation age of maximum volume production for Supkhar Chir is some where between 35 and 45 years or say 40 years.

Conclusions

An analysis of the data of Sample Plot No. 6 and 8 of Supkhar Chir plantations show that :

(i) The site quality conforms to All India Q. I/II of Chir

(ii) The growth of diameter, height and volume/ha of the main crop is comparatively higher than the yield table figures of Chir Q. I/II.

(iii) The total volume/ha of Supkhar Chir plantation at different ages varies from four to two times of yield table figures for Q. I/II.

(iv) The mean annual volume increment (MAVI) of Supkhar Chir is consistently higher than that of yield table figures of Chir, Sal and Teak of Q. I/II. Almost the same trend is depicted in the case of current annual volume increment.

(v) The rotation age of the maximum volume production for Supkhar Chir is about 40 years.

There is an acute shortage of long fibred raw material for the pulp and paper industry in the country. The National Commission on Agriculture have also recommended to undertake large scale plantations of fast growing species to meet this growing demand. To achieve this object, country wide attempts are being made to introduce exotic tropical pines by undertaking extensive trials with various species and their provenances at considerable cost, labour and time.

The irony is that the lure for exotic tropical pines has shadowed the indigenous chir pine. However, it is evident from the analysis of the growth of Supkhar Chir sample plots that it is a fast growing species, its MAI being over 12 m^3/ha/year; it is a short rotation crop and thus can be harvested at the age of 40 years; it can be planted in frosty grassy blanks in Sal forests thereby increasing the productivity of forests; it provides long fibre raw material for pulp and paper industry; in addition to resin, it has been reported that it a starts producing fertile cones at the age of about 20 years or so. Thus, considering all these plus points, it is suggested that :

(a) The Supkhar Chir should be given the status of a provenance as it has tropicalised itself.

(b) Blanks in Sal forests may be planted with the Chir of Supkhar seed origin with a view to increase the productivity of the forests.

(c) Study of the genetic behaviour of Supkhar Chir vis-a-vis natural Chir in sub-tropical region may be undertaken.

(d) Tests on the wood properties and the experiments on resin tapping need to be undertaken.

(e) Much advances in the nursery and plantation techniques of Chir have been made since these plantations were raised in 1907. Thus, it is possible to further improve the growth rate and thus reduce the rotation age.

Table

Showing the Comparative Statement of Mean Annual and Current Annual Volume Increment

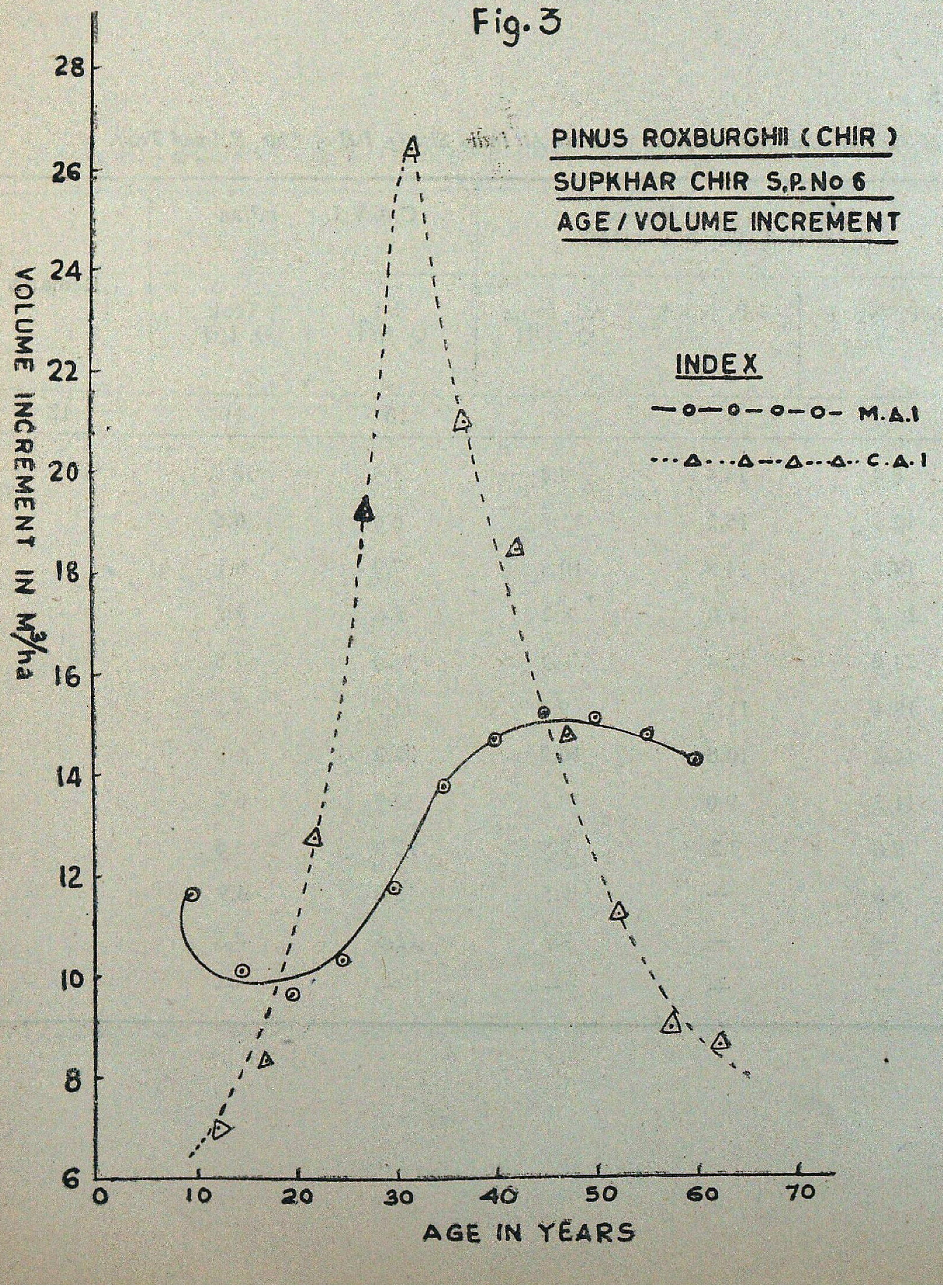
Age in years	Mean Annual Volume/Increment of Chir pine. m^3/ha.			Mean Annual Vol. Increment m^3/ha.	
	S.P. No. 6	S.P. No. 8	All India Q. I/II	Sal Q. I/II	Teak Q. I/II
1	2	3	4	5	6
15	10.1	11.1	9.1	3.3	10.6
20	9.7	11.9	9.8	3.8	10.6
25	10.3	12.6	11.0	4.4	9.8
30	11.8	12.9	10.6	5.0	9.2
35	13.8	13.1	8.2	5.7	9.1
40	14.7	13.0	8.2	6.3	8.9
45	15.2	12.8	9.2	6.8	8.7
50	15.1	12.5	10.2	7.3	8.5
55	14.8	12.2	10.2	7.9	8.3
60	14.3	11.8	9.8	8.3	8.1
65	—	—	9.5	8.7	7.8
70	—	—	9.2	8.9	7.6

5

of Supkhar Chir Sample plots vis-a-vis All India Site Q. I/II of Chir, Sal and Teak.

Current Annual Volume Increment Chir Pine m^3/ha.			C.A.V.I. m^3/ha		Remarks
S.P. No. 6	S.P. No. 8	All India Q. I/II	Sal Q. I/II	Teak Q. I/II	
7	8	9	10	11	12
8.4	14.4	9.8	5.5	10.5	
12.8	15.2	11.0	6.8	6.8	
19.2	14.8	10.6	7.9	6.1	
26.4	14.0	8.2	9.6	8.2	
21.0	12.4	8.2	10.6	7.8	
18.4	11.2	9.2	11.2	7.1	
14.8	10.0	10.2	12.2	6.9	
11.2	9.0	10.2	12.9	6.2	
9.0	7.2	9.8	12.9	5.5	
8.6	—	9.5	13.0	4.9	
—	—	9.2	12.6	4.6	
—	—	—	—	—	

Fig. 3


PINUS ROXBURGHII (CHIR)
SUPKHAR CHIR S.P. No 6
AGE / VOLUME INCREMENT
INDEX
M.A.I
C.A.I
VOLUME INCREMENT IN M³/ha
AGE IN YEARS
6
8
10
12
14
16
18
20
22
24
26
28
0
10
20
30
40
50
60
70

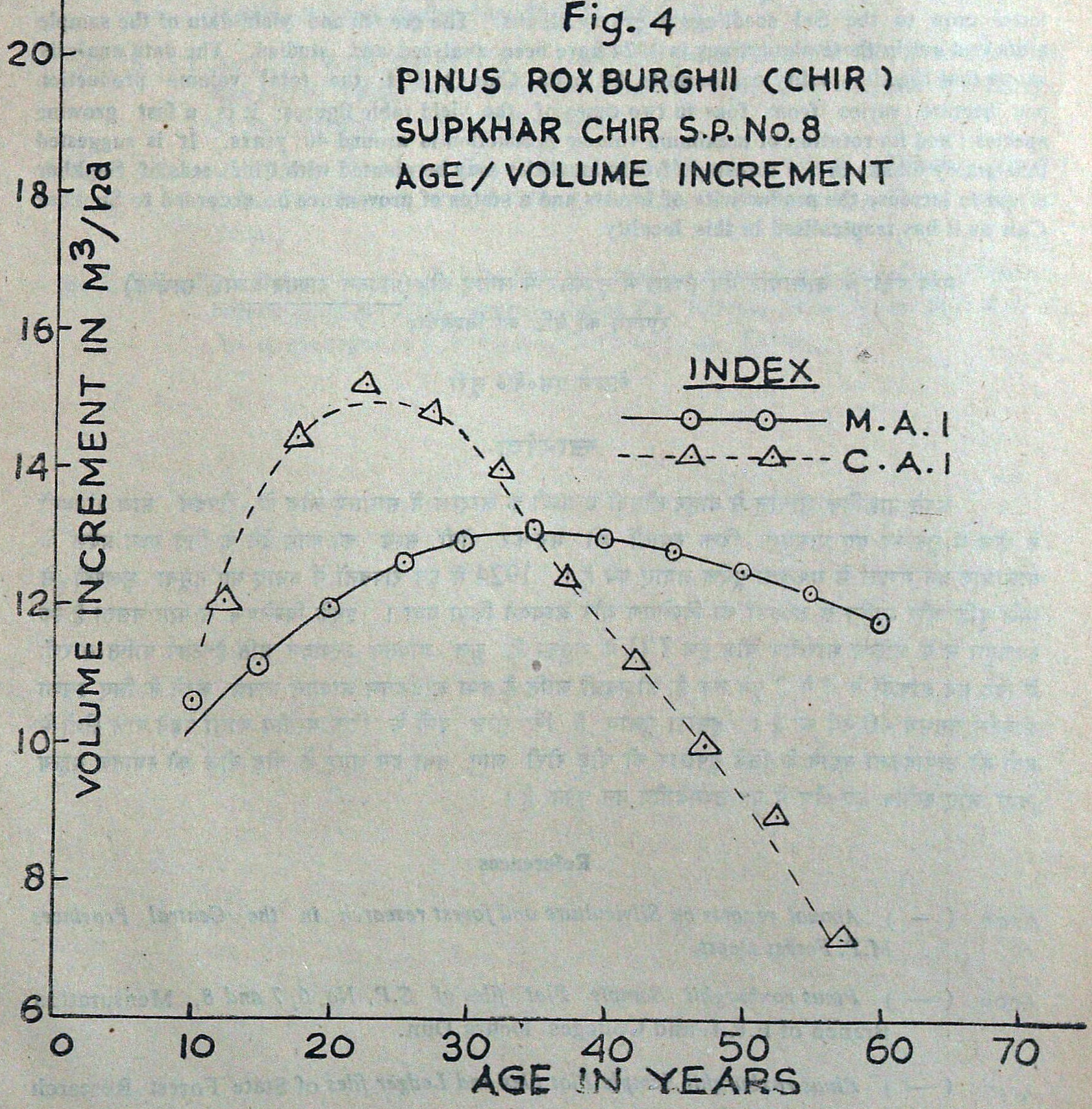


Fig. 4
PINUS ROXBURGHII (CHIR)
SUPKHAR CHIR S.P. No. 8
AGE / VOLUME INCREMENT
INDEX
M.A.I
C.A.I
VOLUME INCREMENT IN M³/ha
AGE IN YEARS
0
10
20
30
40
50
60
70
6
8
10
12
14
16
18
20

SUMMARY

Out side its natural habitat, successful Chir pine plantations were raised in the beginning of the twentieth century in Balaghat Division of Madhya Pradesh with a view to provide a nurse crop to the Sal seedlings in grassy blanks. The growth and yield data of the sample plots laid out in these plantations in 1924 have been analysed and studied. The data analysis shows that the site quality conforms to All India Chir Q. I/II; the total volume production per hectare varies from four to two times of the yield table figures; it is a fast growing species ; and its rotation of maximum volume production is around 40 years. It is suggested that grassy blanks in Sal forests in frosty localities may be planted with Chir seeds of Supkhar origin to increase the productivity of forests and a status of provenance be accorded to Supkhar Chir as it has tropicalised in this locality.

मध्य प्रदेश के बालाघाट वन मण्डल में सूपखार में लगाए चीड़ (पाइनस राक्सबर्धिआई, सार्जेन्ट) रोपवन की वृद्धि का विश्लेषण

लेखक एस०के० सूरी

सारांश

अपने प्राकृतिक आवास से बाहर बीसवीं शताब्दी के आरम्भ में सामान्य चीड़ के रोपवन साल रोपवनों के बीच में छूटे रह गए घासयुक्त रिक्त स्थानों को भर कर पोषी सस्य का काम देने के लिये मध्य प्रदेश के बालाघाट वन मण्डल में सफलता पूर्वक लगाए गये हैं। 1924 में इन रोपवनों में बनाए गए नमूना भूखण्डों से मिले वृद्धि और प्राप्ति के आँकडों का विश्लेषण और अध्ययन किया गया। इनके विश्लेषण से पता चलता है कि स्थलगुण में ये अखिल भारतीय चीड़ गुण I/II के अनुरुप हैं, कुल आयतन उत्पादन प्रति हेक्टेयर प्राप्ति सारणी में दिये गये आँकड़ों से 4 से 2 गुने तक है, शीघ्रवर्धी जाति है तथा अधिकतम आयतन उत्पन्न करने के लिए इसका आवर्तन लगभग 40 वर्ष का है। हमारा सुझाव है कि साल वनों के रिक्त घासीय पाला पड़ने वाले क्षेत्रों में वनों की उत्पादकता बढ़ाने के लिये सूपखार की चीड़ रोपी जाए तथा इस जगह के चीड़ बीज को स्थानज महत्व दिया जाए क्योंकि इस क्षेत्र में यह उष्णदेशीय बन चुका है।

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PHYSICAL WORK-LOAD IN TREE FELLING AND CROSS CUTTING OPERATIONS

(A CASE STUDY IN TROPICAL RAIN FORESTS OF THE WEST COAST)

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Introduction

Scientific forest management and silviculture works are carried out through out the rotation period to provide better growing conditions to tree crops of higher volume and value. Forestry is a production activity which cannot be managed with out workers. Forest management, thus, must have the responsibility not only to ensure favourable growing environment to trees but also ensure proper working conditions to men working in the woods. Forest workers engaged in production activities of timber harvesting should have prospects for good health and improvements in their working conditions and living standard. The foresters, however, tend to be more concerned about trees than about men and human implimation in forestry operations is often ignored. Forest harvesting works have long been regarded outside the purview of forestry science, these were left in the hands of non professional individuals, parties and rural work force with no scope for creativity and ingeniousness to improve the traditional and age-old working tools and methods.

Logging works in Indian forestry are predominantly done by manual methods. Tree felling, limbing and even cross cutting are carried out by axe and hand saws which are of old design and are often ill-maintained. In most cases the cutting action on wood is more due to the manual force than for the efficiency of the tool. The ignorant forest worker is subjected to heavy work-load and physical strains for prolonged work hours. Such undue work stresses can be reduced by application of appropriate level of technology through improvements in working techniques, tools and equipments. The physical work performance is also a combined result of workers capacity for energy output through aerobic and an aerobic processes, muscle strength, skill and motivation to work. The worker must be equipped with proper tool, technique and work environment. There is not yet much information available on work physiology norms in Indian forestry.

The present study has been conducted in the tropical rain forests of the West-Coast in Karnataka State to determine the physical work capability of forest workers in terms of maximal aerobic power and energy cost of cutting operations in tree felling and cross-cutting with traditional axe, hand saws and the improved hand saws.

Plate 1

A group of forest workers used as experimental subject

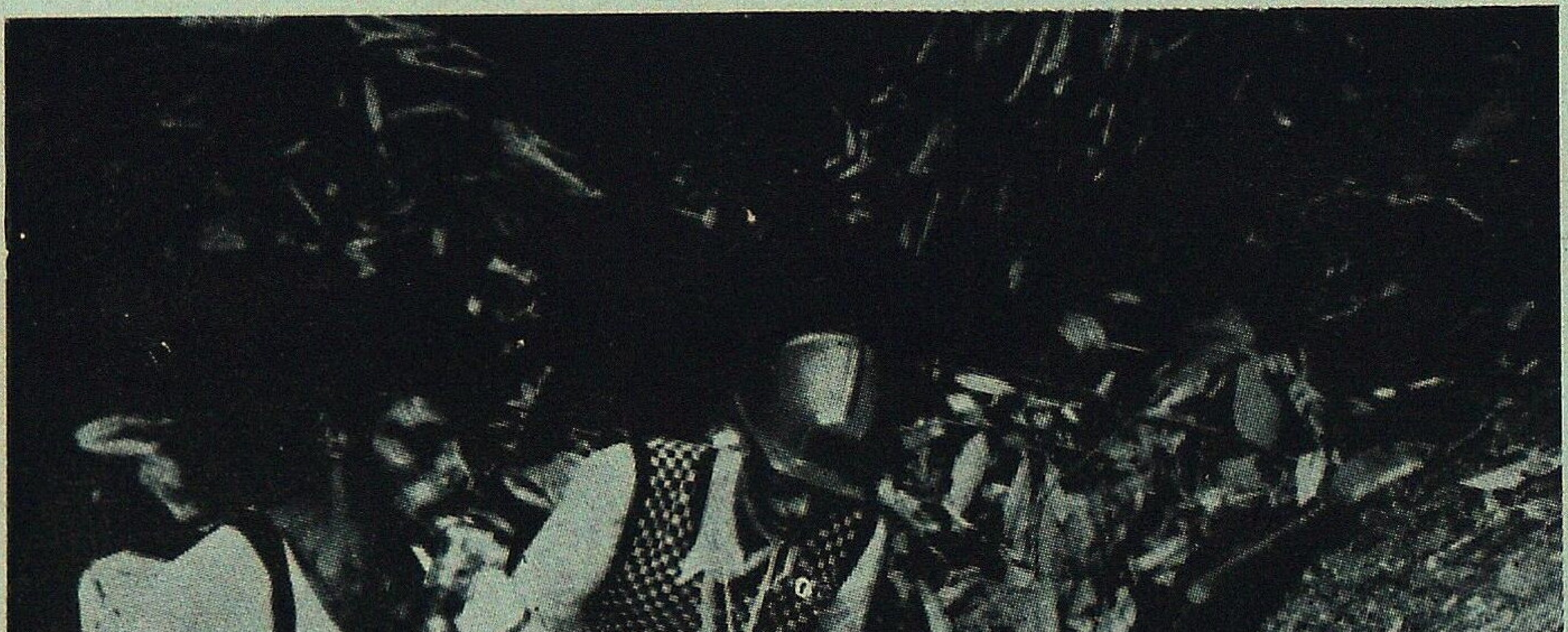
Plate 2

Excercise on Cycle Ergometer

Plate 3

Felling with Malabar axe

Plate 4



Cross-cutting by saws

Study area and the experiment

The field experiment was carried out in Jan./Feb., 1983 in Uppangamalai forest Block of Medikeri Forest Divison, falling in the Ghat forests of Coorg region and lying between latitude 11°55′ and 12°45′ North and longitude 75°21′ and 76°07′ East, in Karnataka State, India. The elevation of the area is about 1100 metres varying from 900 metres to 1300 metres. The rainfall is very heavy. The average annual rainfall is about 5000 mm of which 80 per cent is during the South-West monsoon, from June to September. On the higher reaches, weather is temperate for most part of the year, but it becomes very hot and damp during hot weather from February to June, when the monsoon breaks. The tempereture varies from 50°F in cold season to 100°F in hot season. The day temparature during the study period varied from 64 to 73°F (average 69°F) dry bulb temperature corresponding to 60 to 67°F (average 63.47) wet bulb temperature. The humidity varied from 68% to 90% with average of 78.12%.

The forests in the experimental area are evergreen type with luxurient growth of trees. The trees in the top storey are very tall going upto 45 metres, the most valuable of these species which are used for plywood are—*Vateria indica* (Velthapaini), *Dipterocarpus indicus* (Kalpaini), *Artocarpus hirsuta* (Aini), *Harduickia pinnata* (chonapaini), *Mesua ferrea* (Atha), *Canarium strictum* (Pandapaini). The middle storey consists of *Albizzia*, *Artocarpus*, *Diospyros* species and *Grewia* etc. with dense undergrowth of reeds and creepers. The cutting experiments were carried out with tree species in the top storey. The trees were being felled for plywood industry. The felling was by selection system on 135 year rotation for above plywood species on 45 year felling cycle, the exploitable size being over 6 feet girth. The number of trees available for felling were expected to be about 15 trees per hectare.

The felling of trees was being carried out mainly by axe (Malabar Axe) and common saw having triangular and narrow gullets. Most trees were heavily buttressed which were first chopped off by axe, the workers mostly relied on axe than saw for felling and also cross-cutting of even large size logs. The saws which were poorly maintained were sparsely used in felling. A deep sink cut was made by axe and a small back felling cut by saw just to bring down the tree. Smaller size logs and poles are cut by axe only and firewood are made by axe cutting; the use of bow saw is almost unknown. The labour came from Malabar region. The Malayalees and the Paniyars having good built and sttength were considered very good for felling and cross-cutting works. They earned daily wages of Rs. 30 to Rs. 40. The lighter works were done by the Kudiyars. The labourers were imported from Malabar area to Coorg forests who worked for 3 to 4 month a years.

Selection of experimental subjects. Ten physically active workers who opted to become experimental subjects were selected from a group of over fifty workers working in the felling coupe. The age, height, body weight and resting pulse rates were recorded.

Table 1

Personal data of experimental subjects

Sl. No.	Code name	Age in years (approx.)	Height (cm)	Weight (kg)	Resting pulse rate/min.
1.	SA	27	165	60	80
2.	SB	32	160	60	78
3.	SC	19	150	53	85
4.	SD	43	165	60	90
5.	SE	31	170	58	85
6.	SF	36	170	62	62
7.	SG	37	170	57	90
8.	SH	38	162	58	85
9.	SI	24	168	60	85
10.	SJ	30	157	45	85
11.	SK	—	—	—	—
	Averages	31.70 ±7.15	163.70 ±6.58	57.30 ±4.97	85.30 ±4.06

Results and Discussions

The bicycle Ergometer has been used for physical exercise to measure the aerobic capacity of each subject. The workload and rate has been monitored by changing friction load from 300 Kpm per minute, keeping the pedalling rate constant at 20 Km/hour. Cycle Ergometer exercise test were taken in the morning and were extended over two days for each subject gradually increasing the friction load to 600, 900, 1050 and 1200 Kpm/min. The workers were quite unwilling to take to higher loads than 900 Kpm/min; only one person took load upto 1200 Kpm/min, three upto 1050 Kpm/min and the other five took only upto 900 Kpm/min. Pulsometer stop-watch has been used for recording pulse rate every minute of work till the steady state was reached at which the samples of the expired gas were collected in rubber bladers by mouth piece and closed nose arrangement through Max-Plank gasmeter.

The expired gas was collected for two minutes during steady—state for each work-load. The oxygen uptake was determined by analysing the sample gas in Orset gas analyser apparatus and the energy cost was computed by Weir's method. The maximal (which is submaximal in some cases) aerobic capacity and pulmonary ventilation of the test sujbects are given in the Table 2.

Table 2

Observed maximal aerobic capacity of experimental subjects

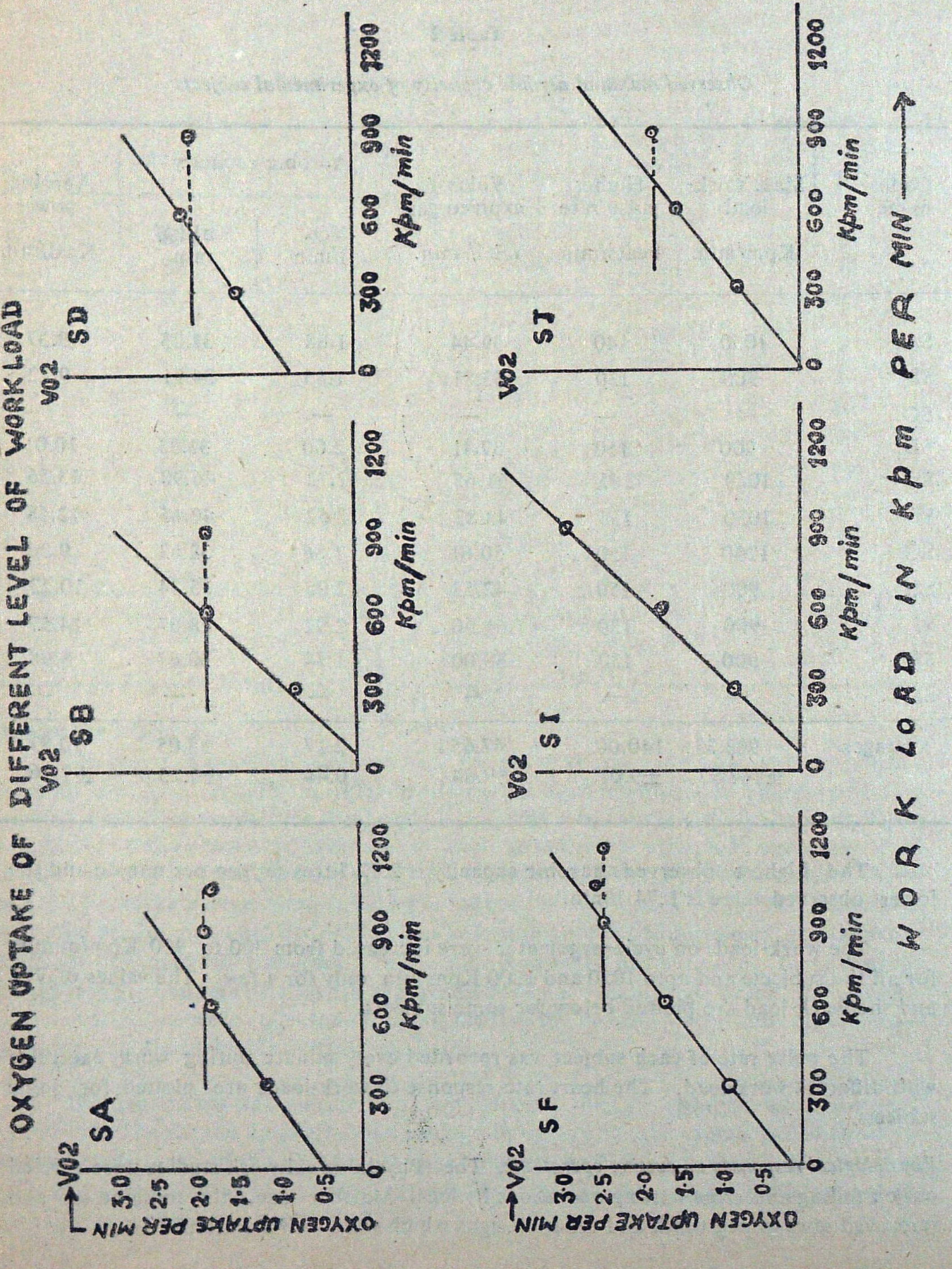
Code name	Max. work-load Kpm/min.	Highest pulse rate beats/min	Vole of expired gas VE l/ min.	Aerobic capacity		Aerobic power Kcal/min.
				VO_2 l/min	ml/kg/ min	
SA	1050	140	39.44	1.88	31.33	9.37
SB	900	130	53.81	1.85	34.91	9.22
SC	—	—	—	—	—	—
SD	900	150	37.41	2.00	33.33	10.01
SE	1050	145	61.65	2.72	46.90	13.56
SF	1050	135	43.82	2.52	40.65	12.58
SG	1200	150	50.61	1.86	32.63	9.26
SH	900	150	42.53	2.05	35.34	10.23
SI	900	130	61.60	2.92	48.67	14.57
SJ	900	130	38.00	1.74	38.67	8.68
SK	—	—	—	—	—	—
Averages	983.33 ±108.97	140.00 ±9.01	47.65 ±9.64	2.17 0.44	38.05 ±6.25	10.83 ±2.16

The highest observed aerobic capacity is 2.72 litres oxygen per minute and the lowest observed value is 1.74 l/min.

The work-load on cycle-ergometer were increased from 300 to 900 Kpm/minute for all the subjects and upto 1050 and 1200 Kpm/min only for a few. The values of VO_2 and the work-load are plotted below for some subjects.

The pulse rate of each subject was recorded every minute during work excercise with different work-load. The heart rate response to work-loads are plotted for some subjects.

Physiological responses in cutting operations. The Physiological work studies were carried out on felling and cross-cutting operations by local Malabar axe, the common saw and improved saws in peg-tooth and raker designs which were well maintained.


OXYGEN UPTAKE OF DIFFERENT LEVEL OF WORK LOAD
SA
SB
SD
SF
SI
SJ
V02
OXYGEN UPTAKE PER MIN
3·0
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2·0
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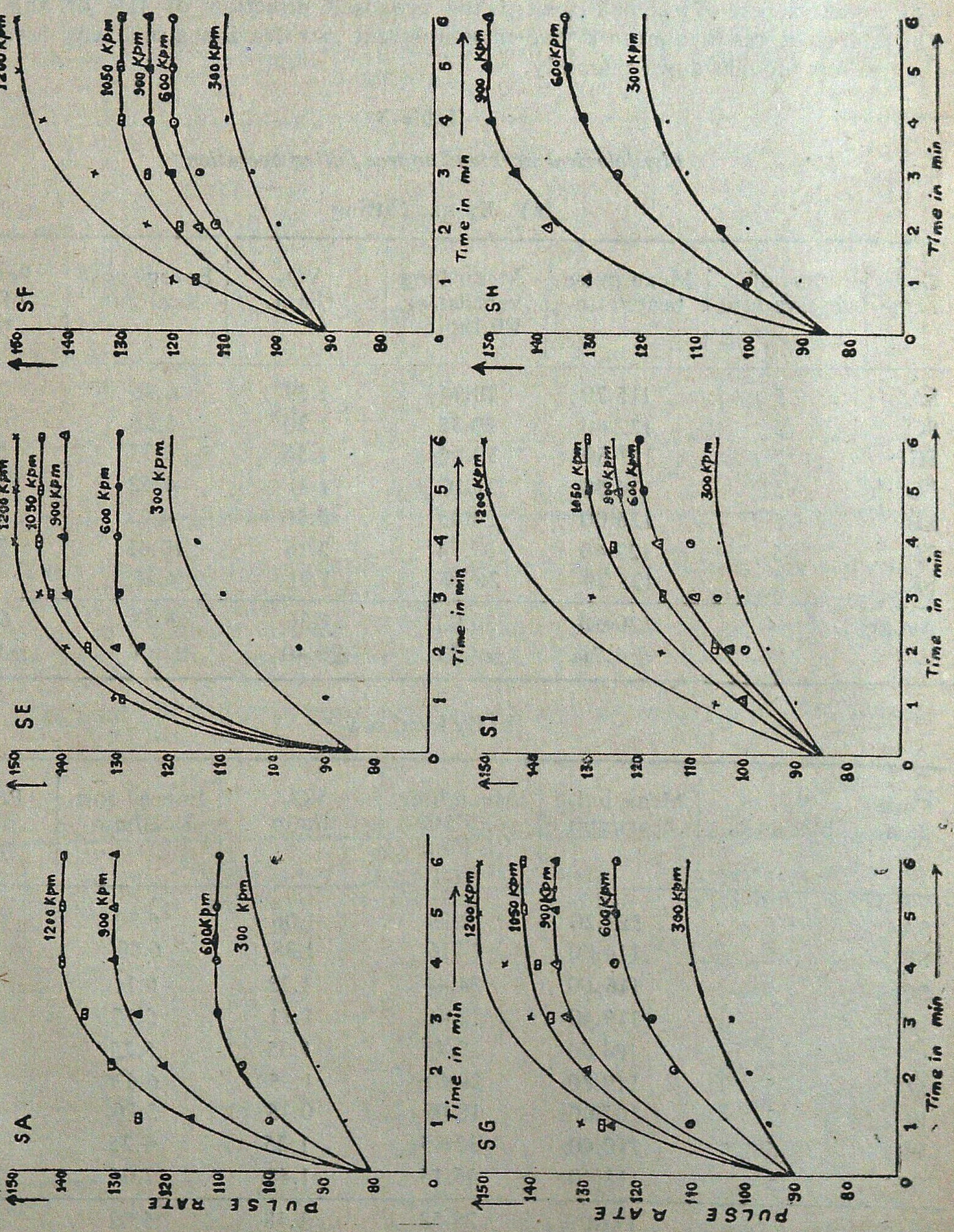
1·0
0·5
0
300
600
900
1200
Kpm/min
WORK LOAD IN Kpm PER MIN



—INCREASE IN PULSE RATE WITH TIME FOR DIFFERENT WORKLOAD—

Felling was done by first Chopping off the buttresses and then making a deep sink cut at the base of tree bole towards the proposed direction of fall of the tree. The felling cut was then given by two-man cross cut saw leaving a sufficient break-off, the tree was brought down smoothly.

Table 3

Physiological workload on tree felling operation

(a) By axe cutting

Code name	No. of observations	Mean pulse beats/min.	Mean lung ventilation VE l/min.	VO_2 l/min.	Energy cost Kcal/min.	Per cent of VO_2 max.
SA	5	115.20	28.94	1.39	6.96	74.00
SC	5	122.60	30.35	1.20	5.96	—
SF	5	117.60	30.84	1.36	6.77	54.00
SG	5	114.50	31.10	1.31	6.52	70.00
SH	5	126.00	24.95	0.86	4.27	42.00
SI	5	122.40	37.74	2.16	10.82	74.00
SK	5	125.20	26 29	1.21	6.15	—
Averages	—	120.50 ±4.71	30.03 ±4.13	1.36 ±0.40	6.78 ±2.00	62.8 ±14,25

(b) By local saw

Code name	No. of observations	Mean pulse beats/min.	Mean lung ventilation VE l/min	VO_2 l/min	Energy cost Kcal/min	Per cent of VO_2 max.
SA	5	123.20	29.99	1.06	5.30	56
SB	5	114.00	27.16	1.38	6.89	75
SC	5	116.60	34.44	1.23	6.11	—
SD	5	119.40	22.48	1.11	5.15	56
SF	5	124.60	26.45	1.05	5.25	42
SG	5	119.80	29.67	1.35	6.63	73
SH	5	107.00	18.05	0.75	3.76	37
SI	5	110.40	32.85	1.25	6.25	—
SK	5	118.40	36.15	1.48	7.06	44
Averages	—	117.00 ±5.75	28.58 ±5.78	1.18 ±0.22	5.82 ±1.05	54.7 ±14.91

(c) By improved saws

Code name	No. of observations	Mean pulse beats/min.	Mean lung ventilation VE 1/min.	VO_2 l/min	Energy cost Kcal/min	Per cent of VO_2 max.
SA	5	108.20	26.52	1.00	4.99	53
SB	5	109.80	25.71	0.92	4.60	50
SC	5	110.80	20.25	0.65	3.23	—
SD	10	119.40	31.11	1.07	5.30	54
SF	10	116.10	29.23	1.11	5.52	45
SG	10	118.30	28.98	1.42	7.16	76
SH	10	117.80	25.18	0.97	4.83	47
SI	10	116.80	30.98	1.36	6.81	47
SK	5	112.40	30.73	1.28	6.43	—
Averages	—	114.40 ±4.14	27.63 ±3.58	1.09 ±0.24	5.43 ±1.22	53.00 ±10.87

The average values of physiological responses such as heart rate, VO_2 and energy cost of work as derived in above tables (a), (b) and (c) for axe, local saw and improved saw respectively indicate that the workload is heavy on axe working, it is low for local saw than axe and the workload is lowest while working with improved saw.

The results of studies on cross-cutting by axe and saw are given in the following table.

(a) By axe

Code name	No. of observation	Mean pulse beats/min.	Mean lung ventilation	VO_2 l/min	Energy cost Kcal/min	% of VO_2 max.
SA	5	121.40	28.39	1.18	5.89	63
SC	5	115.80	39.56	1.79	8.89	—
SG	5	122.00	33.08	1.66	8.30	90
SH	5	113.80	21.42	0.78	3.92	38
SI	5	112.00	33.98	1.46	7.29	50
Averages	—	117.00 ±4.50	31.29 ±6.79	1.37 ±0.40	6.86 ±1.99	60.25 ±22.16

(b) By local saws

Code name	No. of obser-vation	Mean pulse beats/min	Mean lung ventilation	VO_2 l/min	Energy cost Kcal/min	% of VO_2 max	Energy cost Kcal/m²
SA	5	125.40	37.34	1.55	7.71	82	—
SB	1	113.00	19.90	1.08	5.38	38	—
SC	5	119.80	25.65	0.95	4.71	—	179.52
SD	5	120.40	22.50	1.16	5.79	58	—
SF	5	114.40	25.82	1.17	5.82	46	—
SH	5	111.80	24.41	0.90	4.47	44	—
SI	5	119.00	29.83	1.23	6.11	42	—
SK	5	112.00	31.52	1.41	6.74	—	391.86
Averages	—	116.90 ±4.92	27.12 ±5.55	1.18 ±0.22	5.84 ±1.05	52 ±15.07	285.69 ±150.15

(c) By improved saws

Code name	No. of obser-vation	Mean pulse beats/min	Mean lung ventilation	VO_2 l/min	Energy cost Kcal/min	% of VO_2 max	Energy cost Kcal/m²
SA	5	122.00	24.38	0.99	4.89	53	197.17
SB	12	110.25	19.09	0.83	4.13	45	157.03
SC	5	113.20	33.46	1.31	6.55	—	—
SD	10	122.00	29.71	1.12	5.58	56	—
SF	10	119.90	30.44	1.18	5.41	47	81.94
SG	10	117.50	25.65	1.06	5.30	57	299.43
SH	10	108.00	23.10	0.88	4.41	43	—
SI	10	112.90	30.72	1.21	6.06	41	—
SK	10	113.53	31.28	1.17	6.20	—	291.08
Average	—	115.48 ±5.09	27.54 ±4.70	1.08 ±0.16	5.39 ±0.80	49 ±6.35	205.33 ±91.97

(d) Billeting by bow saw

Code name	No. of observation	Mean pulse beats/min	Mean lung ventilation	VO_2 l/min	Energy cost Kcal/min	Energy cost Kcal/ m^2 surface area cut
SL	10	103.00	18.84	0.57	3.37	82.60
SM	10	102.50	20.69	0.85	4.23	146.87
SN	10	102.10	21.68	0.80	3.75	102.73
SO	10	96.70	25.40	0.92	4.60	119.80
SP	9	89.67	25.17	0.97	4.84	132.24
Averages	—	98.79 ±5.70	22.36 ±2.86	0.82 ±0.06	4.16 ±0.62	116.85 ±25.08

In cross cutting, the work-load on axe working is 60.25% of the maximal aerobic capacity of workers as compared to 52.00% with local saw and only 49.00% with improved saws. In terms of energy cost of work, it is 6.86 Kcal per minute of work with axe 5.84 Kcal/min. for local saws, 5.39 Kcal/min for improved saw and only 4.16 Kcal/min for bow saw. The energy cost of work output as Kcal per square metre area cut is 285.69 Kcal/m^2 for local saws, 205.33 Kcal/m^2 for improved saws and only 116.85 Kcal/m^2 for bow saw working. The heart rate responses to work-load also indicates highest workload with axe. Improved design two-man cross cut saws and bow saws are most light and efficient tools for wood cutting. The use of these improved tools must be propagated.

Conclusion

The aerobic capacity and energy output of Malabar forest workers in the West Coast forests have been found to be VO_2 as 2.17 litres/min. which is quite high compared to workers in Central India (VO_2 1.87 l/min). Physiological studies carried out with cutting operations with axe, local saw, improved saw and bow saw have shown that the work-load and physiological responses are high for axe and local saws compared to improved saws and bow saws. The cutting efficiency of improved saws is also much higher. Efforts should, therefore, be made to replace the conventional axe and saws with improved tools in order to reduce workers physical strain and improve work efficiency.

Acknowledgements

The help and co-operations rendered by Shri A.V.Y. Reddy, Conservator of Forests, his officers and staff are thankfully acknowledged. Without their help it would not have been possible for the research field party to stay and work in the remote felling area. All the members of the field party, namely S/Shri C.M. Sharma, M.L. Chhabra, M.L. Shishoo, L.D. Khurana, Shyam Lal and Amerjeet Singh did good job inspite of many difficulties that they had to bear in the field.

SUMMARY

Forestry is a production activity which cannot be managed without workers Forest management must have responsibility not only to provide favourable growing conditions and good silviculture to tree crops, but to ensure proper working conditions to the men working **in the woods. Human implication in forest management have been quite ignored. Our logging methods are manual. Age-old axe and saws are being used for felling and cross cutting. The workers are subjected to very high physiological work-load while working with primitive tools which are often ill-maintained and ergonomically poorly designed. Work performance is a combined result of workers capacity to energy out-put, his muscle power, skill, tool and technique. Therefore, an appropriate technology has to be developed to improve efficiency of work output and reduce manual work-load.**

The present study has been carried out in tropical rain forests of the West-Coast in Karnataka State to find the aerobic capacity of forest workers and physiological work stresses on tree felling and cross-cutting operations with traditional tools and also with improved manual tools such as raker-saw and bow-saw. The results of the study are quite revealing The work capacity of workers in West-Coast forests has been found better as compared to workers in Central Indian forests The energy costs of work can be reduced appreciably if the workers use improved hand saws than the traditional local axe and saw. It is of paramount importance that the use of improved saws should be propagated and workers much be trained in improved logging methods.

वृक्ष पातन में भौतिक कार्यभार तथा आड़ी कटाई प्रक्रियाएं

(पश्चिमी सागरतट के उष्णदेशीय वर्षा वनों में किया गया एक अध्ययन)

लेखक बी०पी० मलेटा व के०जी० सूद

सारांश

वानिकी उत्पादन करने का ऐसा कार्य है जिसे मजदूरों के बिना नहीं कराया जा सकता। वन प्रबन्ध को वृक्ष सस्यों के लिए अनुकूल वृद्धि दशाएं और अच्छा वन संवर्धन उपलब्ध कराने का ही दायित्व नहीं लेना होगा अपितु वनों में काम करने वाले मजदूरों के लिए उपयुक्त कार्यदशाएं भी सुनिश्चित करानी होंगी। अभी तक वनों के प्रबन्ध में मानवों के योग की उपेक्षा की गई है। प्रकाष्ठ-निष्कासन की रीतियां हमारी मानवाधारित हैं। पातन और आड़ी कटाई में युगों पुरानी कुल्हाड़ी और आरे उपयोग में लाए जाते हैं। इन आदिम औजारों

से काम करते हुए जिनका रखरखाव भी ठीक से नहीं किया जाता तथा जिनका आकल्पन ऊर्जा उपयोग विचार से घटिया होता है, कर्मकरों को अत्यधिक भारी शारीरिक कर्यभार सहन करना पड़ता है। कार्य सम्पादन कार्य में लगाई गई ऊर्जा के प्रति कर्मकर की अपनी क्षमता, पुट्ठों की शक्ति, कौशल, औजार और काम करने की प्रविधि इन सबका मिला जुला परिणाम होता है। इसलिए काम करने में कार्य दक्षता बढ़ाने और शारीरिक कार्य भार को कम करने के लिए उपयुक्त प्रौद्योगिकी विकसित करना बहुत आवश्यक है।

वर्तमान अध्ययन कर्णाटक राज्य के पश्चिमी सागर तट वाले उष्णदेशीय वर्षा वनों में पारम्परिक औजारों तथा परिष्कृत मानव चलित औजारों जैसे कुरेदक आरा और धनुष आरों से वृक्ष पातन और आड़ी कटाई कार्य कराते समय वन कर्मकरों की वायु ग्रहण क्षमता और उनके शरीर पर पड़ने वाले दबावों को ज्ञात करने के लिए किया गया है। अध्ययन से मिले परिणाम काफी आंख खोलने वाले हैं। पश्चिमी तट के वनों में काम करने वाले मजदूरों की कार्य क्षमता मध्य भारत के वनों के मजदूरों की तुलना में श्रेष्ठतर पाई गई है। पारम्परिक स्थानीय कुल्हाड़ी और आरे उपयोग करने के बजाय यदि कर्मकर परिष्कृत हस्त चालित आरे काम में लाएं तो काम में खर्च होने वाली ऊर्जा में काफी कमी की जा सकती है। यह बहुत अधिक महत्वपूर्ण बात है कि परिष्कृत आरों का उपयोग प्रचारित किया जाए तथा कर्मकरों (मजदूरों) को परिष्कृत प्रकाष्ठ-निष्कासन रीतियों का प्रशिक्षण दिया जाए।

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A NOTE ON THE WORKING QUALITY AND FINISH ADAPTABILITY OF RUBBERWOOD (*HEVEA BRASILIENSIS*)

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Introduction

Rubberwood (*Hevea brasiliensis*) from spent rubber trees is reported to be available from South India in the log form to the tune of about 80,000 m^3 per annum. This huge wood resource, however continues to be underutilized. Presently it is being used for match splints, packing cases, compressed wood textile looms, shuttles, compressed wood plain shuttles, shuttering, for concrete castings in limited quantities and bulk as fuelwood. It has hardly been put to any wider utilization. The main hinderances in its proper utilization may be attributed partly to its suceptability to attack by insects and fungi and partly on account of lack of information on its seasoning and preservation behaviour. For like reasons it continues to be an underutilized wood resource.

Recent investigation on its utilization indicate that its heartwood is amenable to preservative treatment (Tisseverasinghe, 1969). It can be seasoned (Sharma and Kukreti, 1981) rapidly and compares well with aini (*Artocarpus hirsutus*) and chikrassy (*Chukrasia tabularis*). Bow and twist are common defects but not too severe and little over size would preclude these defects, Its shrinkage is comparable to moderately light wood species like bonsum (*Phoebe* spp) Kanju (*Holoptelia integrifolia*), thitmin (*Podocarpus* spp) and hathipala (*Pterospermum acerifolium*) and moderately heavy woods like chikrassy (*Chukrasia tabularis*), badam (*Terminalia procera*), kokko (*Albizia lebeck*) which have been considered suitable for making joinery and furniture. It shrinks somewhat less than several other joinery and furniture timber species like toon (*toona ciliata*), walnut (*Juglans regia*), Champ (*Michlia champaca*), makai (*Shorea assamica*), pynima (*Lagerstroemea hypoleuca*), vellapine (*Veteria indica*), kaim (*Mitragyna parvifolia*) and white chuglam (*Terminalia bialata*). It is reported to be quite promising in bending.

Keeping in view the above facts, its light weight (Sp. gr. 0.45 gms/cm^3), fairly good strength properties, light cream colour, straight grains and moderately coarse texture it was considered worthwhile to evaluate its working qualities and finish adaptability also so as to assess its overall suitability for light furniture work, bentwood articles and many such other items where it can be profitably employed.

Material used

Testing material for this study was obtained in log form from Kerala which was primarily converted into 2.8 cms thick planks, and later converted to obtain specimens for Turning, Boring, Mortising and Planing operations and also for studying the finish adaptability.

Experimental

(*a*) *Working qualities.* Working qualities of rubberwood was studied under four major wood working operations viz. Turning, Boring, Mortising and Planing employing the same procedure as detailed in ASTM D-1666-64 and suitably modified by Rawat *et al* (1974) on analysing the data using quantitative method of evaluation and visual examination of the test specimens for quality of the finished surface and ease of operation under the above operations, the following conclusions were arrived at.

(i) *Sawing* : It is easy to work in sawing and machining. In Sawing, keeping in view its density (0.45 gm/cm^3) narrow gauge saw blade with teeth having front rake of 20° and top clearance angle of 15° should be used for achieving good results as suggested by Haris (1946).

(ii) *Planing* : In planing cutters set at 30° give very smooth surface.

(iii) *Turning* : It is good in turning.

(iv) *Mortising and Boring* : It was not possible to obtain clear surface under these operations mainly because of defects like fuzziness and tearing off, of grains and crushing.

(*b*) *Finish adaptability.* For studying the finish adaptability specimens of size 30 × 5 × 1 cms were prepared and polished with five different treatments of surface preparation viz,

(1) Base of chalk powder and then spirit polish.
(2) Spirit polish only
(3) Coating of raw lin-seed oil and then spirit polish.
(4) Base of mixture of Animal glue and chalk powder and then spirit polish.
(5) Base of chalk powder, a coat of varnish and then spirit polish.

The rubberwood samples untreated and treated were polished and then % Gloss was observed on a gloss meter with respect to reflection on a glass plate. Results are given in Table 1.

(c) *Bleaching* : Presence of blue stains in rubberwood lowers its value as a furniture and cabinet making timber. Removal of blue stains completely and or partially improving the colour of surrounding timber containing blue stains will go a longway in utilising this timber for furniture and cabinet making. Experiments were thus conducted to study the effect of two commonly used bleaching agents viz. Bleaching powder (CaOCl) and sodium hypochlorite (NaOCl) on (1) samples containing blue

Table

Observations on % gloss developed and

Sl. No.	Surface preparation	Untreated (blue stain free)		Untreated
		% Gloss	Appearance after finish	% Gloss
1.	Chalk powder+spirit polish	79	Very slightly darkened, uniform finish.	77
2.	Spirit polish	71	Appears no change in colour, fairly smooth finish.	76
3.	Lin-seed oil+spirit polish	71	Non-uniform and dull finish.	81
4.	Animal glue+chalk powder+ spirit polish.	71	Uniform finish, develeps reddish tinge.	77
5.	Chalk powder+varnish+ spirit polish.	75	Finish not very uniform poor pore filling.	80

1

appearance of the finished rubberwood specimens.

(blue stained)	Ammonia treated blue stain free		Ammonia treated blue stained	
Appearance after finish	% Gloss	Appearance after finish	% Gloss	Appearance after finish
Blue stains slightly darkened, uniform finish.	90	Very slightly darkened very uniform finish.	80	Blue stains more prominent, finish not uniform.
Blue stains darkened to brownish colour fairly smooth finish.	92	Slightly darkened finish not very uniform.	88	Blue stains taking greenish tinge, finish not uniform rather dull.
Blue stains darkened to brown colour, fairly smooth finish.	91	Considerable change in colour (dark) finish very uniform and smooth.	85	Blue stains taking brownish tinge, finish not uniform.
Appears no change in colour. Dull finish.	90	Not much change in colour, finish not very smooth.	86	Blue stains darkening slightly, finish not uniform rather dull.
Finish not very uniform. Poor pore filling.	90	Not much change in colour finish not very smooth.	85	Blue stains slightly darkened finish not uniform rather dull.

stains and (2) samples which did not contain blue stains. In this study 2.5% solution of bleaching powder and neat solution of sodium hypochlorite on few samples of rubberwood of the above mentioned two categories were applied and two coats were given to each of the samples. Samples with sodium hypochlorite solution treatment were washed with lukewarm tap water and then were spirit polished. Since rubberwood has good bending properties and has scope for its use in bentwood articles where Ammonia treatment for plasticizing may be given, it was thought necessary to extend experiments on Ammonia treated wood also to see the effect of bleaching agents. The % Gloss of these samples was recorded and averaged values are reported in Table 2.

Table 2

Measurement of % Gloss Effect of Bleaching agents

Sl. No.	Chemical used	Type of specimen	%	Observations
1.	Control	Blue stain free untreated	83	
2.	CaOCl 2.5 % solution	Blue stained	83	No appreciable change in blue stains.
3.	CaOCl 2.5 % solution	Blue stain free untreated	78	Colour improved
		Blue stained NH3 treated	84	No appreciable change in blue stains.
4.	NaOCl Neat solution	Blue stained	90	—do—
5.	NaOCl Neat solution	Blue stain free untreated	89	Colour slightly improved.
		Blue stain free NH3 treated.	79	—do—

(d) *Colouring.* Since bleaching treatment did not show any marked improvement in either getting rid off the blue stains present in rubberwood samples nor it could improve the colour of the surrounding wood containing blue stains, colouring of rubberwood was tried for enhancing its value for furniture and cabinet making.

Rubberwood samples treated with 2.5 % solution of bleaching powder were painted with turkey amber coloured chalk powder and then sanded off. After two such coatings and sanding, the samples were spirit polished. % Gloss of these samples was recorded and averaged values are given in Table 3.

Table 3

Measurement of % Gloss, Ammonia treated colour imparted samples.

Base	Polish	% Gloss
1. Turkey amber coloured chalk powder	Spirit and shellac polish	71

Results and Discussion

The study of results presented in Table 1 reveals that Ammonia treated rubberwood free from blue stains has exhibited good appearance and has given better % gloss in all the five preparations of surface and polishing as compared to samples under similar conditions but containing blue stains. % gloss in the former case was even better than untreated rubberwood.

Referring to Table 2 and comparing the results obtained after employing the two mentioned bleaching agents it is inferred that application of neat solution of sodium hypochlorite over rubberwood samples containing blue strains has comparatively been better than those where 2.5 % solution of bleaching powder has been used. Though no marked change in colour was oberved in either case yet the appearance of samples treated with neat solution of sodium hypochlorite was somewhat better.

Referring to Table 3 where, % gloss of bleaching powder treated colour imparted samples of rubberwood is 71% and is minimum amongst the treatments given to similar samples referred above. Inspite of the low % gloss the colour appearance has been quite good and advocates for its use in furniture items of medium quality.

Acknowledgement

Authors wish to express their thanks to Shri S.N. Sharma, Officer-in-Charge, Wood Seasoning Branch for supplying the material and S/Shri Shyam Lal Sharma and Shyam Singh Mall for assisting in the above investigations.

SUMMARY

Working qualities and finish adaptability of rubberwood, hitherto underutilized timber, are reported in the present paper.

The timber is easy to work and is suitable for light furniture after preservative treatment. It takes polish satisfactorily. Blue stained timber gives good appearance when spirit polished with Turkey amber coloured chalk powder base.

रबर काष्ठ (हीविया ब्राजिलिएंसिस) के कार्य गुण और परिष्करण अनुकूलनता के विषय में एक टिप्पणी

लेखक के०एस० शुक्ल, आर०सी० भटनागर व बी०सी० पंत

सारांश

रबर काष्ठ के, जिसका उपयोग अभी तक बहुत कम किया गया है, कार्य गुण और परिष्करण अनुकूलन क्षमता की जानकारी प्रस्तुत अभिपत्र में दी गई है।

यह काष्ठ काम करने में सुगम है तथा परिरक्षी उपचार कर देने पर हल्का उपस्कर (फर्नीचर) बनाने के लिए उपयुक्त रहता है। इस पर पालिस (प्रमार्जक) अच्छी चढ़ती है। नीले धब्बों वाली लकड़ी तुर्की अम्बर रंग की खड़िया के चूरे को आधार बना कर बनाई स्पिरिट पालिश से चमकाने पर बहुत अच्छी लगती है।

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AN ABNORMAL SEEDLING IN TEAK

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Bulk seed of ***Tectona grandis***, from a number of seed sources, was procured at Coimbatore Centre of the Indo-Danish Project on Seed Procurement and Tree Improvement in 1978 for provenance trials in different States. After distribution the remaining seed was stored in gunny bags, under room condition. In 1981 this reproductive material was sown in enamel trays containing 1 : 1 : 1 soil mixture after germination. During germination a deviant showing leaf variegation was located. The seed source of this abnormal seedling was Nilambur (Kerala). As the seed of individual sources was bulked it was not possible to trace the parents of this deviant.

Chlorophyll deficient seedlings upto the extent of albino have been reported to occur frequently in conifers (Franklin, 1970). Venkatesh and Emmanual (1970) have indicated the potential value of such chlorophyll deficient seedlings, like mottled, viridis along with albina, as genetic markers.

For Teak this is the first report where the chlorophyll deficiency is maintained from the very first to the eighth leaf pair in a regular fashion. The survival of the seedling is encouraging because it can lead to production of an ornamental teak line in due course of time.

Morphological Description

In the present case the chlorophyll deficiency was observed in one of the two cotyledons as a small patch. The first developing decussate leaf pair, during emergence, appeared to be normal green but during the course of its expansion the expression of white, light yellow and green regions became prominent on the right flank of the lamina of Ist leaf row while the other flank remained normal green. The 2nd leaf pair showed this expression on the left flank of the lamina of 2nd leaf row with the normal green right flank (Plate 1, 2). Successively 3rd, 4th......... 8th leaf pair showed this behaviour maintaining the symmetry and regularity for this expression on the row and the side of the leaves. This differentiation generally started when the young developing leaf was 1 to 2 cm in length.

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The description suggests possible chimaeric origin as the sister plants of this type, under the same edaphic and climatic conditions, were normal and its appearance is very different from the symptoms of chlorosis caused by deficiency of nutrients (Kaul *et al*, 1970).

SUMMARY

An abnormal seedling of Teak *(Tectona grandis)*, in respect of chlorophyll deficiency causing variegation in leaves, has been reported.

सागौन का असामान्य पौधा

लेखक आर०के० वखशस्य व सी०जे०एस०के० इम्मैनुएल

सारांश

सागौन (टेक्टोना ग्रांडिस) के एक असामान्य पौधे का वर्णन दिया गया है जिसमें पर्ण शाद (क्लोरोफिल) की कमी के कारण पत्तियां चितकबरी हो गई हैं ।

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Plate 1

Normal green Teak seedling

Plate 2

Teak seedling with variegated leaves

TWO NEW SPECIES OF *HIPTAGE* GAERTN. (MALPIGHIACEAE) FROM INDIA

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During the course of study on the family Malpighiaceae for Flora of India, the author came across some specimens belonging to two species of *Hiptage* Gaertn. which were found to be new and undescribed. The same are described below :

Hiptage jacobsii Srivastava sp. nov. (Figs. 1-3; Plate I) Differt a *H. benghalensi* (L.) Kurz, lineari—ellipticis, pedunculis et pedicellis tenuibus, calycum glandibus parvioribus, petalorum marginibus denticulatis vel sub-denticulatis non-fimbriatis, samaris ecristatis (Holotypus-Lushai Hills, *Gage* 146 CAL).

Climbing shrubs. Branches woody, glabrous, Leaves linear-elliptic, 5.5–8.5×1.5-2.5 cm, acute at bases, shortly acuminate at apices, sub-coriaceous, glabrous; petioles 3-4 mm long, glabrous. Panicles axillary or terminal; peduncles 3.5–9 cm long, 0.75-1 mm thick, white appressed tomentose; bracts *ca* 1.75 mm long; bracteoles *ca* 1 × 0.75-1 mm. Buds globose or sub-globose, 4–8×4-5 mm; sepals 1.5-2×1-1.5 mm, calycinal glands 1 mm; petals 10–11 mm, denticulate; anthers ovoid *ca* 1×0.5 mm, filaments *ca* 5 mm long; styles 12–13 mm long. Samaras pale brown, ecristate; middle wings elliptic or oblanceolate, 38–43×10–11 mm, sometimes slightly broader in middle, tapering at both the ends, sub-acute or rounded at apices, glabrous; lateral wings obovate, 18–20×7–8 mm.

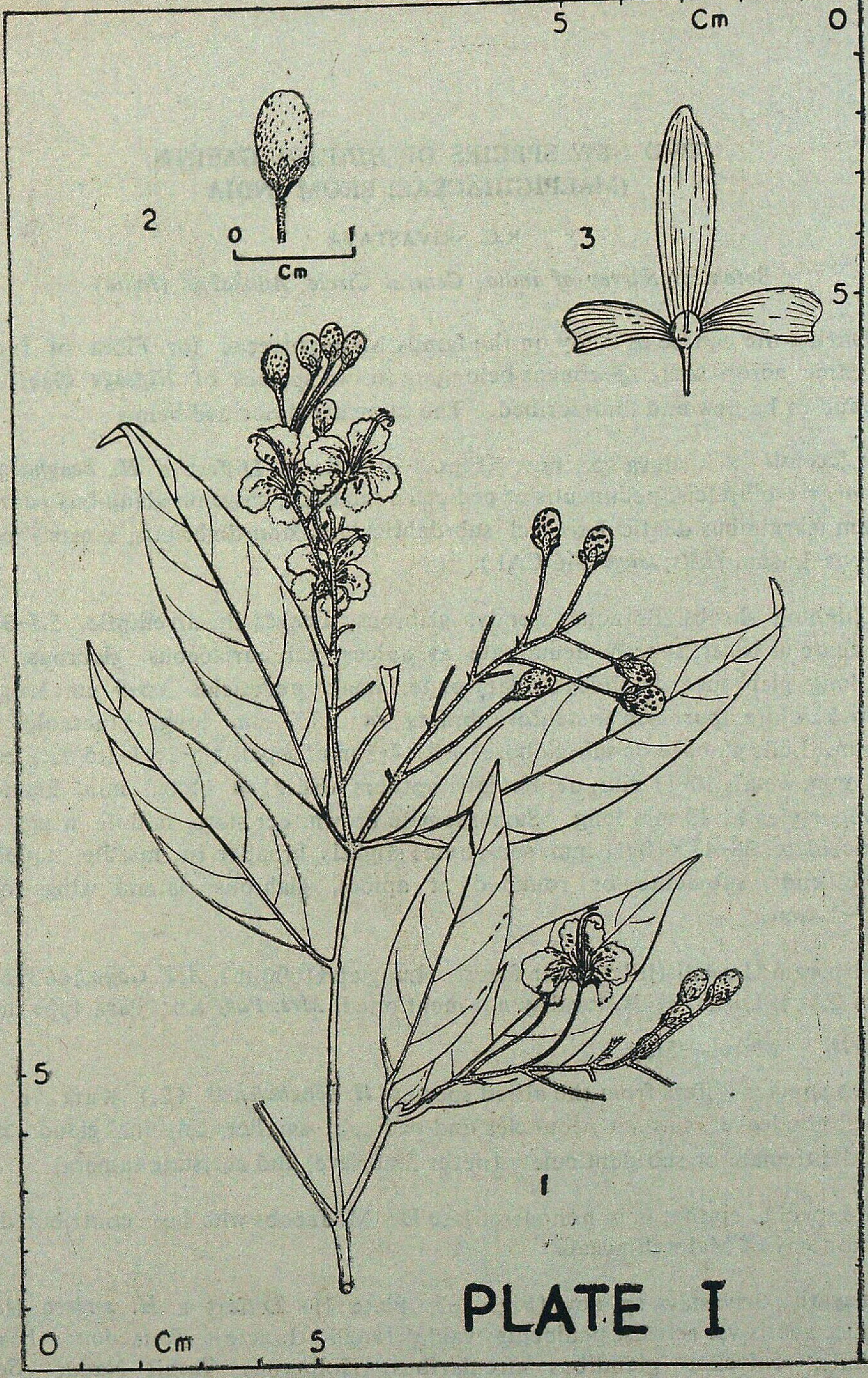
Type : Mizoram (Lushai Hills), Acar forest, Lunglab (1000 m), *A.T. Gage* 146 (Holotype in CAL); Lushai Hills, locality not mentioned, *Mrs. Pary* s.n. (Para type in CAL).

Fls. and frts. : March—May.

This species differs from the allied species *H. benghalensis* (L.) Kurz in having linear—elliptic leaves, thinner peduncles and pedicels, smaller calycinal glands, margins of petals denticulate or sub-denticulate (never fimbriate) and acristate samaras.

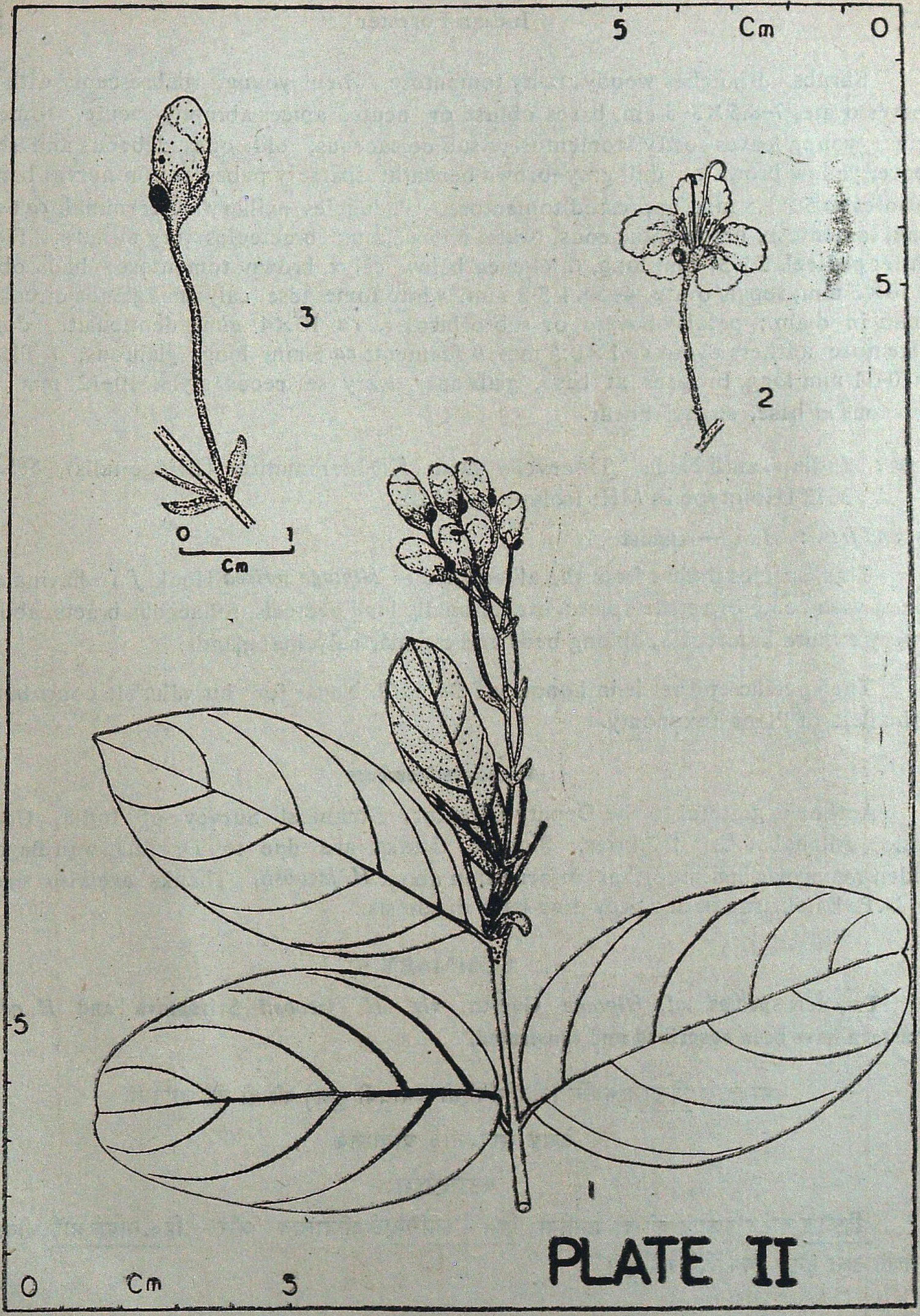
The specific epithet is in honour of late Dr. M. Jacobs who has contributed a lot to the taxonomy of Malpighiaceae.

Hiptage nayarii Srivastava sp. nov. (Fig. 1-3; Plate II) Differt a *H. sericeo* Hook. *f.* foliis ovatis, acutis vel retusis, pedicellis valde longis, bracteis foliaceous, bracteolis minutissimis, calycum glandibus circularibus (Holotypus—Tamil Nadu, *Sebastine* 3673 MH).



Hiptage jacobsii Srivastava

Figs. 1—A twig with leaves, buds and flowers.
2—A bud showing calycinal gland.
3—A samara.



Hiptage nayarii Srivastava

Figs. 1—A twig with leaves and buds.
2—An open flower (2-petals removed) showing stamens and style.
3—A bud showing calycinal gland.

Shrubs. Branches woody, rusty tomentose when young, glabrescent with age. Leaves ovate, 7–8.5×3–5 cm, bases obtuse or acute, apices abruptly acute, sometimes retuse, young leaves softly tomentose, sub-coriaceous, old ones glabrous and shining above, yellow brown or dull grey-brown beneath; sparsely pubescent on nerves beneath; petioles *ca* 5×1.5 mm, appressed tomentose. Peduncles axillary or terminal, *ca* 6–7 cm long, tomentose; bracts foliaceous, ovate, 5–6×2 mm; bracteoles very minute. Flowers white; pedicels 25–37 mm long, thickened below calyx, brown tomentose; buds oblong, *ca* 10×5 mm; sepals ovate, 4–5×1.5-2 mm, white tomentose, calycinal glands circular, *ca* 2 mm in diam.; petals obovate or sub-orbicular, *ca* 10×4 mm, denticulate, dorsally tomentose; anthers ovoid *ca* 1×0.5 mm, 9 filaments *ca* 5 mm long, glabrous, 1 filament *ca* 10–11 mm long, broader at base, glabrous; ovary sericeous, styles 10–12 mm long, sericeous at base, stigma linear.

Type : India, Tamil Nadu, Tinnevelly Dist. Kil-Manimuther (Bridge-falls), *Sebastine* 3673 (Holotype in MH; Isotype in CAL).

Fls. and frts. : June—August.

This species differs from the allied species *Hiptage sericea* Hook. *f* in having ovate leaves with acute or retuse apices, exceptionally long pedicels, foliaceous bracts, abortive or very minute bracteoles, oblong buds and circular calycinal glands.

The specific epithet is in honour of Dr. M.P. Nayar for his valuable contributions in the field of Plant Taxonomy.

Acknowledgements

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SUMMARY

Two new species of *Hiptage* Gaertn. viz. *H. jacobsii* Srivastava and *H. nayarii* Srivastava have been described and illustrated.

भारत से हिप्टाज गार्टेन (मैलपिघिएसी=माधवी कुल) की दो नई जातियां

लेखक आर०सी० श्रीवास्तव

सारांश

हिप्टाज गार्टेन प्रजाति की दो जातियों हि० जेकबसियाई श्रीवास्तव और हि० नायरिआई श्रीवास्तव का वर्णन तथा उनके चित्र दिये गये है।

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A NOTE ON PHYSICAL AND MECHANICAL PROPERTIES OF *LAGERSTROEMIA SPECIOSA* (JARUL) FROM KERALA

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Introduction

Lagerstroemia speciosa (Jarul) is a very large deciduous tree, found in Assam Valley, Chhota Nagpur, Western Coast from South Konkan Southwards. It is chiefly found along river banks and on low swampy ground. It is very hand-some when covered with its large lilac flowers, (Gamble, 1922). The stem is often fluted and not infrequently burrs occur near the base. Its habit is to branch low down the stem and to form a large crown unless forced up by lateral shade. Sapwood greyish-white to pale roseate-white, heartwood light red when first exposed, turning light reddish-brown with age, without characteristic odour or taste, light to moderately heavy, straight grain or nearly so or occassionally broadly wavy grained in radial plane, medium course-textured (Pearson and Brown, 1932). The timber is used for ship building, boats, canoes, constructions and carts, etc. (Gamble, 1922).

Material and Testing

Ten poles of *Lagerstroemia speciosa* (Jarul) from different trees were received from Range Officer, Karulai Range, Nilambur, Kerala. The main object was to conduct full length pole test as per IS : 1900–1974 for determining suitability of the timber species for use as wood poles. Due to large sizes of the poles, it could not be possible to test the material in the pole form. It was therefor considered useful to test the material as per IS : 1708–1969 for evaluating all its important physical and mechanical properties.

The poles received were converted into scantlings of 6.25 × 6.25 cm for various tests in green condition in accordance with clause 8 of IS : 2455–1974. The test specimens were taken out as per schedule given in IS : 2455–1974 (Appendix–C). Tests were conducted as per procedure given in IS : 1708–1969.

Results and Discussions

The results of various physical and mechanical tests carried out in green conditions have been reported in Table 1. The average values in green condition have been reported in Col. 3. The maximum and minimum values observed in the specimens tested in green condition have been reported in Col. 4 and 5. The standard deviations

Table 1

Physical and mechanical properties of Lagerstroemia speciosa (Jarul) from Nilambur, Kerala

Sl. No.	Properties	Green conditions						***Tectona grandis*** (Teak) from Nilambur, Malabar and Coimbatore. Average value in green condition
		Average value	Max. value	Minimum value	Standard deviation	Co-efficient of variation	Expected value	
1	2	3	4	5	6	7	8	9
1.	Specific gravity $\left(\frac{\text{weight oven-dry}}{\text{volume at test}}\right)$	0.522	0.674	0.339	0.026	4.9	—	0.596
2.	Per cent moisture content	41.8	111.1	24.5	—	—	—	76.6
3.	Weight in kg/m^3	740	—	—	—	—	—	1056
4.	Static bending :							
	(i) Fibre stress at elastic limit (kg/cm^2).	375	583	196	56.6	15.1	356	509
	(ii) Modulus of rupture (kg/cm^2)	622	874	333	79.1	12.7	602	841
	(iii) Modulus of elasticity (1000 kg/cm^2)	84.2	139.0	39.2	10.8	12.8	86.6	109.7

1	2	3	4	5	6	7	8	9
	(iv) Work to elastic limit (kg cm/cm^3)	0.099	0.218	0.040	0.023	22.7	0.080	0.134
	(v) Work to Max. Load (kg/cm/cm^3)	0.58	0.87	0.24	0.112	19.3	0.55	0.86
	(vi) Total work (kg cm/cm^3)	1.62	2.48	0.98	0.391	24.1	1.33	1.79
5.	Impact bending :							
	(i) Fibre Stress at elastic limit (kg/cm^2)	816	1104	466	96.6	11.8	869	1085
	(ii) Max. height of drop (22.7 kg hammer) cm	100	178	66	27.7	27.8	72	91
	(iii) Modulus of elasticity (1000 kg/cm^2)	102.6	142.6	56.8	15.5	15.1	123.8	160.6
	(iv) Work to elastic limit (kg cm/ cm^3)	0.365	0.475	0.210	0.051	14.0	0.343	0.414
	(v) Brittleness test. Izod value (kg/ cm)	146	290	69	37.4	25.6	—	129
6.	Compression parallel to grain :							
	(i) Comp. stress at elastic limit (kg/km^2)	185	337	115	19.4	10.5	216	311

(*Contd.*)

1	2	3	4	5	6	7	8	9
	(ii) Max. crushing stress (kg/cm²)	278	419	162	29.5	10.8	302	415
	(iii) Modulus of elasticity (1000 kg/cm²)	76.2	119.3	34.4	15.2	19.9	97.0	129.8
7.	Compression per pendicular to grain :							
	(i) Comp. stress at elastic limit (kg/cm²)	53	79	23	7.7	14.4	56	86
8.	Hardness (Indentation) (Load to embed 1.128 cm dia steel ball to half dia):							
	(i) Radial (kg)	361	508	225	42.4	11.7	375	557
	(ii) Tangential (kg)	360	510	205	42.7	11.9	388	551
	(iii) End (kg)	400	585	285	45.0	11.3	395	486
9.	Shear parallel to grain :							
	(i) Radial (kg/cm²)	74.9	114.3	33.4	10.0	13.3	70.5	89.5
	(ii) Tangential (kg/cm²)	85.1	123.3	55.5	11.9	14.0	78.9	100.2

1	2	3	4	5	6	7	8	9
10.	Tension perpendicular to grain :							
	(i) Radial (kg/cm^2)	37.6	63.2	17.3	5.3	14.2	34.7	68.3
	(ii) Tengential (kg/cm^2)	45.1	66.5	23.8	6.3	14.0	42.9	79.4
11.	Tension parallel to grain :							
	(i) Tensile stress at elastic limit (kg/cm^2)	571	1038	295	141.7	24.8	—	—
	(ii) Max. tensile stress (kg/cm^2)	765	1170	442	147.6	19.3	—	—
	(iii) Modulus of elasticity (1000 kg/cm^2)	81.3	117.5	45.2	16.1	19.8	—	—
12.	Torsion :							
	(i) Torsional shearing stress at elastic limit (kg/cm^2)	48.7	76.1	29.5	5.7	11.7	46.8	54.2
	(ii) Max. torsional shearing stress (kg/cm^2)	106.8	137.0	53.3	16.0	15.0	100.8	124.7
	(iii) Torsional modulus of rigidity (kg/cm^2)	49.1	63.7	35.3	5.7	11 6	62.1	74.7

based on tree average and coefficient of variation of all the properties in green condition are given in Col. 6 and 7. The expected values in green condition calculated from specific gravity strength relationship formulae (Sekhar and Rawat, 1956) are given in Col. 8 for comparison with observed values of the species. The average values of strength properties of standard teak (Malabar, Nilambur and Coimbatore) are also given in Col 9 for comparison of strength properties of this species with those of teak.

On comparison of Col. 3 and 9 of Table 1, it is observed that strength values of *Lagerstroemia speciosa* are generally lower than teak in green condition and the ratio ranges from 55.1% to 90.5% except in maximum height of drop in impact bending test and brittleness test which have some higher values. It may also be seen that expected values in green condition are found to be more or less same as compared to corresponding observed values. The coefficient of variation varies from 4.9% to 27.8% indicating that there is not much variation in strength between the trees.

Based on the modulus of rupture in green condition, this species falls under group 'C' of IS : 876-1970, and it can be tried as wood poles for overhead power and telecommunication lines so far strength is concerned.

SUMMARY

Physical and mechanical properties of *Lagerstroemia speciosa* (Jarul), received from Karulai Range, Nilambur, Kerala and tested in green condition, have been reported and discussed. The results obtained have been compared with standard teak. It is found that values are lower than standard teak in general. Expected values based on strength specific gravity formulae have also been reported for comparison.

केरल के लैगरस्ट्रोमिया स्पीसियोसा (जरूल) के भौतिक और संधारी गुणों के सम्बन्ध में एक टिप्पणी

लेखक जे०डी० जैन व एम०एन० डंगवाल

सारांश

कारूलाई परिक्षेत्र, नीलाम्बुर, केरल से प्राप्त हुई लैगरस्ट्रोमिया स्पीसियोसा (जरूल) का हरी दशा में परीक्षण किया गया तथा उसके परिणाम देते हुए उनका विवेचन किया गया है। परिणामों की तुलना मानक सागौन से की गई है। देखने में यह आया कि सामान्यतः इसकी अर्हाएं मानक सागौन की तुलना में घटकर हैं। शक्ति आपेक्षिक गुरूत्व सूत्र के आधार पर प्रत्याशित अर्हाएं भी तुलनार्थ इसमें दी गई हैं।

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EUCALYPTUS TRIALS FOR RURAL FIREWOOD PLANTATION IN BIHAR

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The population of Bihar has risen from 58.696 millions in 1971 census to 69.91 millions in 1981 census an increase of 19.11 per cent from 1971. Bihar being the 2nd largest State in terms of population the per capita forest area was hardly 0.05 ha on 1961 census as against all India average of 0.14. The forest area has been dwindling after independence continuously, on account of mining, extension of agriculture, Railways and other sectors.

Phenomenal price rise in timber, combined with the poor economic capability of the forest dwellers has resulted in illicit removals of valuable forest wood, in fashioned (Plate 1) and unfashioned (Plate 2) form, wasting as much as 20 to 30% on the site itself to prevent detection of theft and quick transport on shoulders. All these have resulted in severe denudation of site quality and reduction in growing stock.

Govt. of India realised the intensity and sensivity of this great social problem faced by the below-poverty line people and launched the Rural Fuelwood Plantation Scheme in the State of Bihar. It is being implemented in the districts of Santhal Parganas, Giridih, Hazaribagh, Bhagalpur, Aurangabad, Gaya, Dhanbad, Nalanda, Rohtas, Monghyr Nawada i.e. in eleven Districts chronically affected by fuelwood shortage.

Under this programme, the total area planted was 335 hectares in 1981, 7000 hectares in 1982 and 7000 hectares in 1983 at a spacing of 2 m× 3 m and 7800 hectares proposed in 1984 at a spacing of 2 m × 2 m for firewood production. We have been planting locally available seeds in our plantation areas.

There are many sites which are completely barren because there is no top soil. These areas have to be put under vegetative cover quickly. Firewood crops especially take importance in these areas, which has hitherto remain barren or has become barren recently due to human pressure. To promote the idea of growing big sized timber in these areas is not feasible, but trying firewood crops or short rotations is the answer. Thus experimental trials of exotics and indigenous species are necessary before taking up large scale plantation. With this in view, trials were conducted with 17 provenances of *Eucalyptus camaldulensis* (*Eucalyptus camaldulensis* Dehnh Syn.

Eucalyptus rostrata, Schecht commonly known as Red Gum) which is an outstanding fuel species yielding approximately 4800 Kcal per kilogram with a specific gravity 0.6 and one provenances of *Eucalyptus hybrid* (local origin) raised in polythene bags in the year 1979. The pH Range of the Research Centre varies from 5.6 to 6.5.

Table 1

Treatment	Name of provenance	Avg. ht. (m) Dec. '82.	Sample S.D.	Avg. dia. (cm) Dec. '82	Sample standard deviation
T1	Petford	6.06	1.139	5.05	1.692
T2	Goodairs Creek	4.75	1.152	4.30	1.203
T3	Katherine	5.77	0.383	4.82	0.607
T4	Halls Creek	4.53	1.428	3.27	1.569
T5	Gilgandra	4.91	0.316	3.82	0.350
T6	Ewen Marcreek	3.93	0.245	2.40	0.216
T7	Bullock Creek	5.31	0.568	4.02	0.512
T8	Barwan River	3.46	0.256	1.85	0.656
T9	Silverton District	2.84	0.304	2.12	0.373
T10	Murchison River	4.74	0.682	3.72	0.736
T11	Isdell River	4.96	0.541	3.67	0.330
T12	W. Dimbulah	4.85	0.583	3.52	0.842
T13	Avers Rock Turnaff	5.09	0.446	3.82	0.519
T14	Agnew	5.32	0.458	3.95	0.759
T15	Irvine Bank	5.17	0.555	4.10	0.698
T16	Lennard River	4.80	0.846	3.72	0.873
T17	Gwydyr River Moree	3.44	0.607	2.35	0.341
T18	E. Hybrid	4.28	0.178	3.45	0.129

The volume is calculated by the following equation

(i) $\sqrt{V} = -0.0868 + 2.8335\ D$

Where V is volume in m^3
and D is diameter in m

(ii) Expected volume in m^3 = volume in m^3 per plants × 2500

(iii) Actual volume in m^3 = Expected volume in m^3 Deduct
— (Expected vol. in m^3 × casualty %)

Table 2

Treatment	Name of provenance	Volume (m^3) per plant	Expected (a)	Volume (m^3) Actual (b)	Casualty %
T1	Petford	0.003168	7.92	7.524	5.0
T2	Goodairs Creek	0.001228	3.07	1.381	55.0
T3	Katherine	0.002478	6.19	6.190	Nil
T4	Halls Creek	0.000034	0.08	0.068	15.0
T5	Gilgandra	0.000459	1.15	0.977	15.0
T6	Ewen Marcreek	0.000353	0.88	0.594	32.5
T7	Bullock Creek	0.000735	1.84	1.794	2.5
T8	Barwan River	0.001182	2.95	0.811	72.5
T9	Silverton District	0.000714	1.78	0.756	57.5
T10	Murchison River	0.000346	0.86	0.408	52.5
T11	Isdell River	0.000295	0.74	0.481	35.0
T12	W. Dimbulah	0.000167	0.42	0.367	12.5
T13	Avers Rock Turnaff	0.000459	1.15	0.632	45.0
T14	Agnew	0.000631	1.58	1.303	17.5
T15	Irvine Bank	0.000863	2.11	1.782	17.5
T16	Lennard River	0.000346	0.86	0.576	40.0
T17	Gwydyr River Mores	0.000408	1.02	0.357	65.0
T18	E. Hybrid	0.00012	0.30	0.255	15.0

Table 3

Treatment	Name of provenance	Avg. ht. (m)	Standard deviation	Avg. dia (cm)	Standard deviation	Volume (m^3) per plant
T1	Petford	7.84	1.1556	6.05	1.7987	0.00716
T2	Goodairs Creek	6.53	1.6197	5.17	1.8081	0.00356
T3	Katherine	7.66	0.6877	5.97	0.7632	0.00678
T4	Halls Creek	4.73	1.7522	3.60	1.9113	0.00023
T5	Gilgandra	5.24	0.8115	4.62	0.6652	0.00194
T6	Ewen Marcreek	4.30	0.3198	2.62	0.2500	0.00016
T7	Bullock Creek	6.47	0.7583	4.57	0.7500	0.00182
T8	Barwan River	3.76	0.7672	1.86	0.9609	0.00116
T9	Silverton District	2.88	0.4837	1.65	0.3873	0.00160
T10	Marchison River	5.98	0.6177	4.65	0.9849	0.00202
T11	Isdell River	6.15	0.5548	4.37	0.3304	0.00137
T12	W. Dimbulah	6.43	1.2513	4.05	1.3127	0.00078
T13	Avers Rock Turnaff	5.73	0.6949	4.15	0.9255	0.00095
T14	Agnew	6.53	0.8830	4.05	0.9832	0.00166
T15	Irvine Bank	6.66	0.8928	4.92	1.0468	0.00277
T16	Lennard River	6.44	1.1993	4.52	0.9535	0.00170
T17	Gwydyr River Moree	4.06	0.4144	2.47	0.4500	0.00028
T18	E. Hybrid (Local)	4.78	0.3632	4.05	0.5802	0.00078

Table 4

Treat-ment	Name of provenance	Volum (m^3)	Volume (m^3) Expected	Actual	Casualty (%)
T1	Petford	0.00716	17.90	16.6625	12.5
T2	Goodairs Creek	0.00356	8.90	4.005	55.0
T3	Katherine	0.00678	16.95	16.95	Nil
T4	Halls Creek	0.00023	0.57	0.4845	.051
T5	Gilgandra	0.00194	4.85	3.88	20.0
T6	Ewen Marcreek	0.00016	0.40	0.25	37.5
T7	Bullock Creek	0.00182	4.55	4.4437	2.5
T8	Barwan River	0.00116	2.90	0.58	80.0
T9	Silverton District	0.00160	4.00	1.40	65 0
T10	Murchison River	0.00202	5.05	2.2725	55.0
T11	Isdell River	0.00137	3.42	2.223	35.0
T12	W. Dimbulah	0.00078	1.95	1.7062	12.5
T13	Avers Rock Turnaff	0.00095	2.37	1.3035	45.0
T14	Agnew	0.00166	4.15	3.4237	17.5
T15	Irvine Bank	0.00277	6.92	5.536	20.0
T16	Lennard River	0.00170	4.25	2.55	40.0
T17	Gwydyr River Moree	0.00028	0.70	0.245	65.0
T18	E. Hybrid (Local)	0.00078	1.95	1.6575	15.0

Results and analysis

The best result as it appears amongst the provenances *is Katherine Avg. height 5.77 m Standard deviation 0.383 and avg. diameter 4.82 cm and Standard deviation 0.607 in Treatment No.* 3 followed by Bullock Creek avg height 5.31 m Standard deviation 0.568 and avg. dia. 4.02 cm, Standard deviation 0.512 in Treatment No. 7. But among the trertments highest avg. height 5.06 m and highest avg. diameter 5.05 cm is attained by treatment No. T1. Petford but so far as standard deviation is concerned it is 1.139 in height and 1.692 in diameter respectively. The mortality percentages are very low i.e. Nil percentage in treatment No. 3, 2.5% in treatment No. 7 and 5.0 percentage in treatment No. 1. The data above has been examined statistically on the basis of Dec. '82 requirements.

Among the eighteen provenance the provenance No. 3 i.e. Katherine shows the best result in volume production having nil mortality percentage. The second best is provenance No. 7 i.e. Bullock Creek in volume production having 2.5% mortality. But from seeing Table 2 it is found that the treatment No. 1 i.e. Petford yield the actual volume production is 7.524 which is highest among all. But this treatment is not significant while taking into consideration of Table 1.

Date of measurement—Nov. '83.

Analysis based on November '83 measurement

After analysing the data of the above mentioned Plot No. 23 on the basis of measurement taken in Nov. '83, it is found that same treatments i.e. treatment No. 3 Katherine and treatment No. 7 Bullock Creek are giving uniform results in average height, average diameter and volume production. Taking into account of treatment No. 1 (Petford) which is giving the avg. ht. i.e. 7.85 metre and avg. dia 6.06 having sample standard deviation 1.1556 and 1.7987 respectively which is maximum amongst all. This shows that individual group data of this provenance is scattered from the mean line.

Katherine provenance at the age of nearly 4½ years, has lead *Eucalyptus hybrid* by 8.69% in terms of yield, 1.60% in terms of height-growth 1.47% in terms of diameter growth. However, it could not achieve 2 metre in height growth and 20 m in dia growth annually in the first ten years as indicated in National Academy of Sciences Publication "Firewood Crops".

Coppicing power of Eucalyptus stumps

In dry areas good percentage of coppice shoots of Eucalyptus fail to establish and grow into trees (Chaturvedi, 1983). An experiment was conducted on survival of stumps of *Eucalyptus tereticornis* Mysore gum or (hybrid) in Lawa P.F. in Patamda beat of Dhalbhum Forest Division, Bihar, experimental area 63 m × 65 m=4095 m²

or 0.4095 hectare having mean annual rainfall of 170 cms., Soil Sandy loam intermixed with Murrum and gravel planted in 1962 at a spacing of 3 m × 3 m felled in late 1977. Out of expected 455 stumps only 441 stumps were exploited. Counting in Nov. '78 revealed only survival of 330. Thus there was 27% mortality in terms of planted No. and 25.2% mortality in terms of exploited stumps. The highest mortality was found in the class interval of 6 cm—8 cm (28.5%) and followed by class interval 4 cm—6 cm (20%) (N.M. Prasad, 1979).

On 21st January, 1984 the average height of 5.34 metres and average dia. of 5.6 cms and the maximum height of 11 metres and maximum dia. of 12.8 cms were recorded. Another experiment was started in June '78 in *Eucalyptus tereticornis* (hybrid) plantation Poklabera of 1962 at a spacing of 3 m×3 m in an Experimental area or 63 m× 60 m or 3.378 hectare on southern slope having mean annual rainfall of 170 cm. Soil is sandy loam intermixed with murrum and gravel. The area was exploited in early 1979, 429 stumps were exploited. Counting in June '78 revealed that only 302 survived thus 29.60% of stumps died. The highest mortality of 45.4% was seen in the diameter class of 6 cm—8 cm followed by 33.3% in 4 cm—6 cm dia. class. In July '80, total percentage of mortality was 31.93% (Sinha, 1980) whereas in January '84 the mortality increased to 43.89% on the exploited stumps. The average height recorded is 6.06 metres and average dia. 6.2 cm maximum height 13.50 metres maximum dia. 13.4 cms. Thus approximately 1 metre in height growth and 1 cm in dia. growth per year at the age of 6 years has been achieved in first coppice rotation (Upendra, 1984). In such areas of high mortality crop rotation by some leguminous species to improve the site condition is a must and *Acacia auricularformis* or *Cassia siamea* is suggested.

Recommendations

Eucalyptus trees in harsh and marginal areas attract termites and borer more and are indicator of bad site factors which must be avoided (Sen-Sharma, 1983).

In uniformaly vigorously growing crop incidence of damage by disease and pest is rather remote.

Therefore, in Bihar for raising *Eucalyptus* plantation Seth & Kapoor 1978 suggested planting of *Eucalpptus* only on fertile Loamy soil which is atleast 60 cm to 90 cm deep. Govt. orders published in Bihar Gazette extraordinary No. 392 dated 17.4.79 has suggested that even if the structure of the soil is dense and compact and the texture is either clayee or loamy and its depth is 120 cm and above *Eucalyptus* may be planted.

Eucalyptns is exceedingly doing well in the Singhbhum district of Bihar and farmers have special craze in *Eucalyptus* planting extensively under Social Forestry programme due to highly renumerative, excellent demand of straight bole poles and packing cases.

• *Eucalyptus* poles of 6-7 m in length, butt end 50 cm fetch atleast Rs. 250 per tree in Calcutta market.

Acknowledgement

The help of Conservator of Forests, Eucalyptus Research Centre, Hyderabad in providing the seeds for trial Shri S.S. Sharma, R.O.F. in collection of data and Shri Prem Kumar, in processing the data is sincerly acknowledged.

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A NEW SPECIES OF *PILEOSTEGIA* HOOK. f. & Th. (HYDRANGEACEAE) FROM ARUNACHAL PRADESH (INDIA)

H.B. NAITHANI AND S.S.R. BENNET

Systematic Botany Branch,
(Directorate of Biological Research)
Forest Research Institute and Colleges, Dehra Dun (India)

Pileostegia subansiriana Naithani et Bennet sp. nov.

P. viburnoideo Hook. f. and Th. similis tamen differt foliis longioribus nervisque 9-11 paribus, paniculis longioribus, staminibus brevioribus filamentisque ad basin complanatis.

Typus : Hapoli ad Ponge 1800 m, Subansiri regio, 1.11.1977 *Bennet* et *Naithani* 3301 (holotypus DD, isotypus DD).

Pileostegia subansiriana Naithani and Bennet sp. nov.

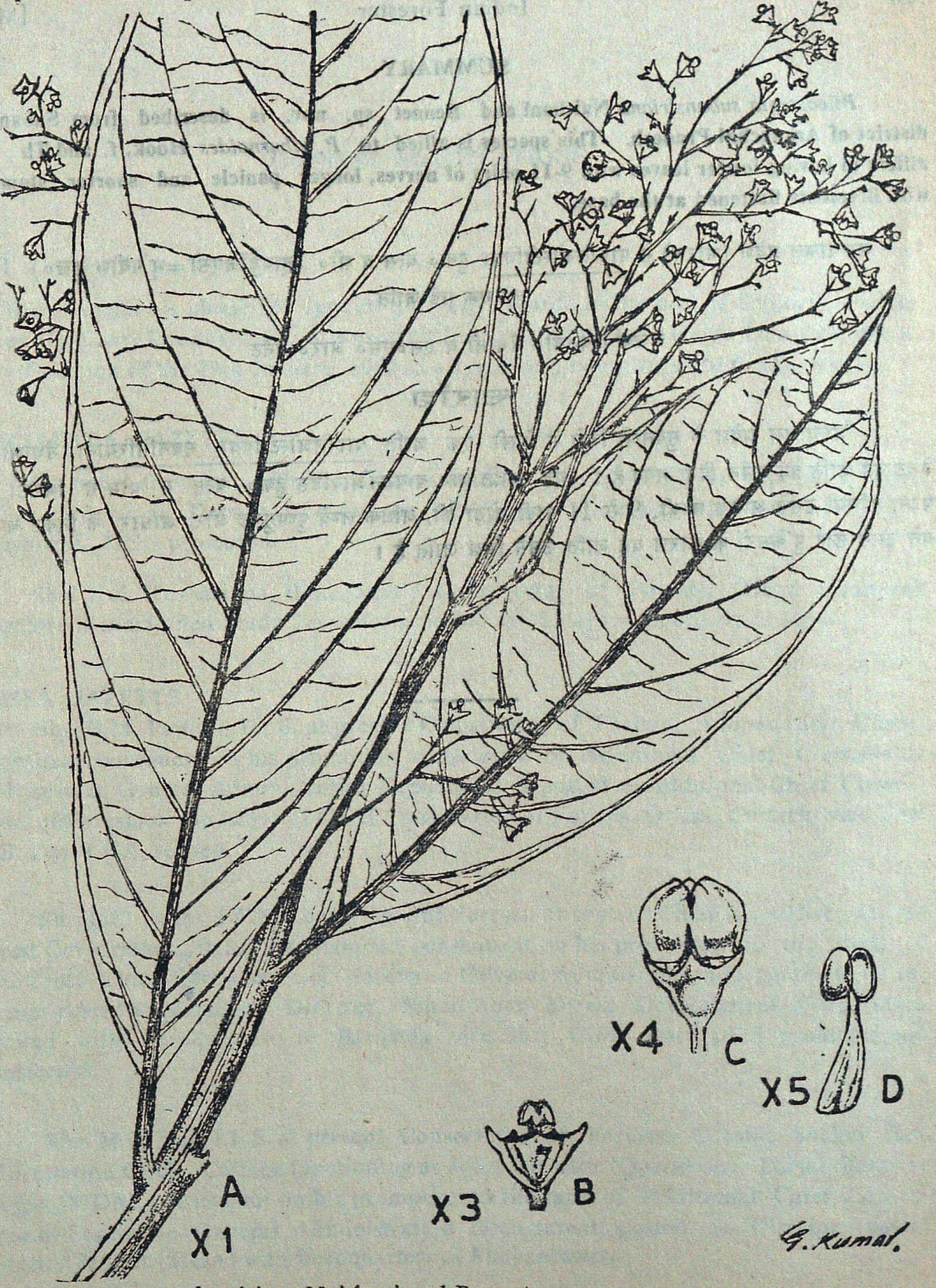
Allied to *Pileostegia viburnoides* Hook. f. and Th., but differs in having longer leaves with 9-11 pairs of nerves, longer panicle and shorter stamens with filaments flattened at the base.

Small tree up to 9 m high. *Leaves* opposite, 11–21 × 5–8 cm, mostly ovate-oblong, acuminate, more or less cuneate, nerves 9–11 pairs prominent, margin entire; petiole 1-3 cm long. *Panicle* terminal, up to 18 cm long and 17 cm wide, bearing many-flowered shortly stalked cymes; bracts ± 1.2 cm long, lanceolate, acuminate, glabrous or sometimes with fascicled hairs. *Pedicels* 1.5-4 mm long. *Receptacle* obovoid, 1.5-2 mm long. *Sepals* triangular, acute, 1 mm long, persistent. *Petals* ovate, cucullate, cohering upwards in a diciduous "calyptra". *Stamens* 10, filaments 1-2 mm long, flattened at the base; anther subglobose, 0.5. mm long. *Ovary* inferior, 5-celled; style columnar, 1 mm long; stigma knob-shaped with 5 decurrent rays of papillae. *Capsule* 2-3 mm long. top-shaped with flat crown. *Seeds* numerous, oblong, 1 mm long.

Type : Hapoli to Ponge 1800 m, Subansiri district, 1.11.1977, *Bennet* and *Naithani* 3301 (holotype DD, isotype DD).

Acknowledgements

Authors are grateful to Shri K.N. Bahadur, Officer-in-Charge, Systematic Botany Branch, F.R.I. for offering valuable suggestions; to the officers and staff of the Arunachal Pradesh Forest Department for providing necessary help in the field; Fr. K.M. Mathew SJ, St. Josephs College, Tiruchirapalli for latin translation and to Shri G. Kumar, Chief Artist for the illustration.



Pileostegia subansiriana Naithani and Bennet
A—Shoot, B—Receptacle, C—Flower D Stamen

SUMMARY

Pileostegia subansiriana **Naithani and Bennet sp. nov. is described from Subansiri district of Arunachal Pradesh. This species is allied to** *P. viburnoides* **Hook. f. and Th , but differs in having longer leaves with 9-11 pairs of nerves, longer panicle and shorter stamens with filaments flattened at the base.**

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सारांश

अरुणाचल प्रदेश के सुवनश्री जिले से मिली एक जाति पाइलिजोस्टीगिया सुबनसिरियाना नैथाणी ब बेनेट नई जाति का वर्णन दिया गया है। यह जाति पा॰ वायबर्नेआयडिस हुक॰ वत्स व थौम से मिलती है, परन्तु पत्तियाँ उससे अधिक लम्बी, 9 से 11 नाड़ी-जोड़ों की, अधिक लम्बे पुष्पगुच्छ और आधार के निकट चपटे बने उससे छोटे पुंकेसरों के कारण यह जाति उससे भिन्न जाति है।

———

GAZETTE NOTIFICATIONS

F.R.I. GAZETTE

The President is pleased to appoint Shri V.N. Sharda to the post of Senior Research Officer (Ordinary Grade) at Forest Research Institute & Colleges, Dehra Dun with effect from forenoon of the 12th January, 1984 in a temporary capacity, until further orders.

KARNATAKA GAZETTE

On return from leave, Shri N. Chandrasekhara Murthy, IFS., is appointed until further orders as Deputy Conservator of Forests, Chickmagalur, vice Shri A.S. Sadashiviah, IFS., promoted.

Shri K.A. Kushalappa, IFS., Deputy Conservator of Forests, (Head Quarters) Bangalore is sanctioned Study Leave for a period of 60 days from 6th April 1984.

ORISSA GAZETTE

Shri B.M. Pujhari, I.F.S. at present Conservator of Forests, Afforestation Circle, Sambalpur consequent on his promotion to the rank of Additional Chief Conservator of Forests in General Administration Department is posted as Additional Chief Conservator, of Forests in the Office of Chief Conservator of Forests, Orissa, Cuttack vice Shri G.G. Das, I.F.S. retired.

Shri S.C. Padhi, I.F.S. Conservator of Forests, at present Chief Executive, Orissa Forest Corporation Limited, Berhampur, consequent on his promotion to the rank of Additional Chief Conservator of Forests in General Administration Department on reversion posted as Managing Director, Similipahar Forest Development Corporation Limited with headquarters at Baripada vice Shri G.M. Das, I.F.S. promoted and transferred.

Shri M.C. Das, I.F.S. at present Conservator of Forests, Coastal Shelter Belt Afforestation Circle, Cuttack functioning as Joint Director (Operation), Social Forestry Project (SIDA), consequent on his promotion to the rank of Additional Chief Conservator of Forests in General Administration Department posted as Director, Social Forestry Project (SIDA) with headquarters at Bhubaneswar.

Shri G.S. Padhi, I.F.S, Conservator of Forests, at present Chief Executive, Orissa Forest Corporation Limited, Bhubaneshwar on reversion from the said Corporation, is posted as Conservator of Forests, Afforestation Circle, with headquarters at Sambalpur, vice Shri B.M. Pujhari, IFS promoted and transferred.

The services of Shri M.F. Ahmed, I.F.S., at present Assistant Chief Conservator of Forests in the office of Chief Conservator of Forests, Orissa, Cuttack, consequent on his promotion to the rank of Conservator of Forests in General Administration Department are placed at the disposal of Orissa Forest Corporation Limited for appointment as Chief Executive, vice Shri G.S. Padhi, I.F.S. transferred.

Shri Sourindra Bose, I.F.S. at present Deputy Conservator of Forests, Forest Resources Survey Division, Cuttack, consequent on his promotion to the rank of Conservator of Forests in General Administration Department is posted as Joint Director, Social Forestry Project (SIDA), Bhubaneswar.

Shri L.K. Jagdev, I.F.S., at present Planning Officer in the Office of Chief Coservator of Forests, Orissa, Cuttack consequent on his promotion to the rank of Conservator of Forests in General Administration Department is posted as Joint Director, Social Forestry Project (SIDA), Bhubaneswar.

The services of Dr. C.R. Mohapatra, I.F.S. at present Forest Utilization Officer, Cuttack, are placed at the disposal of Orissa Forest Corporation Ltd.. vice Shri S.C. Padhi, IFS, Conservator of Forests, Chief Executive, O.F.C. Ltd., promoted and transferred.

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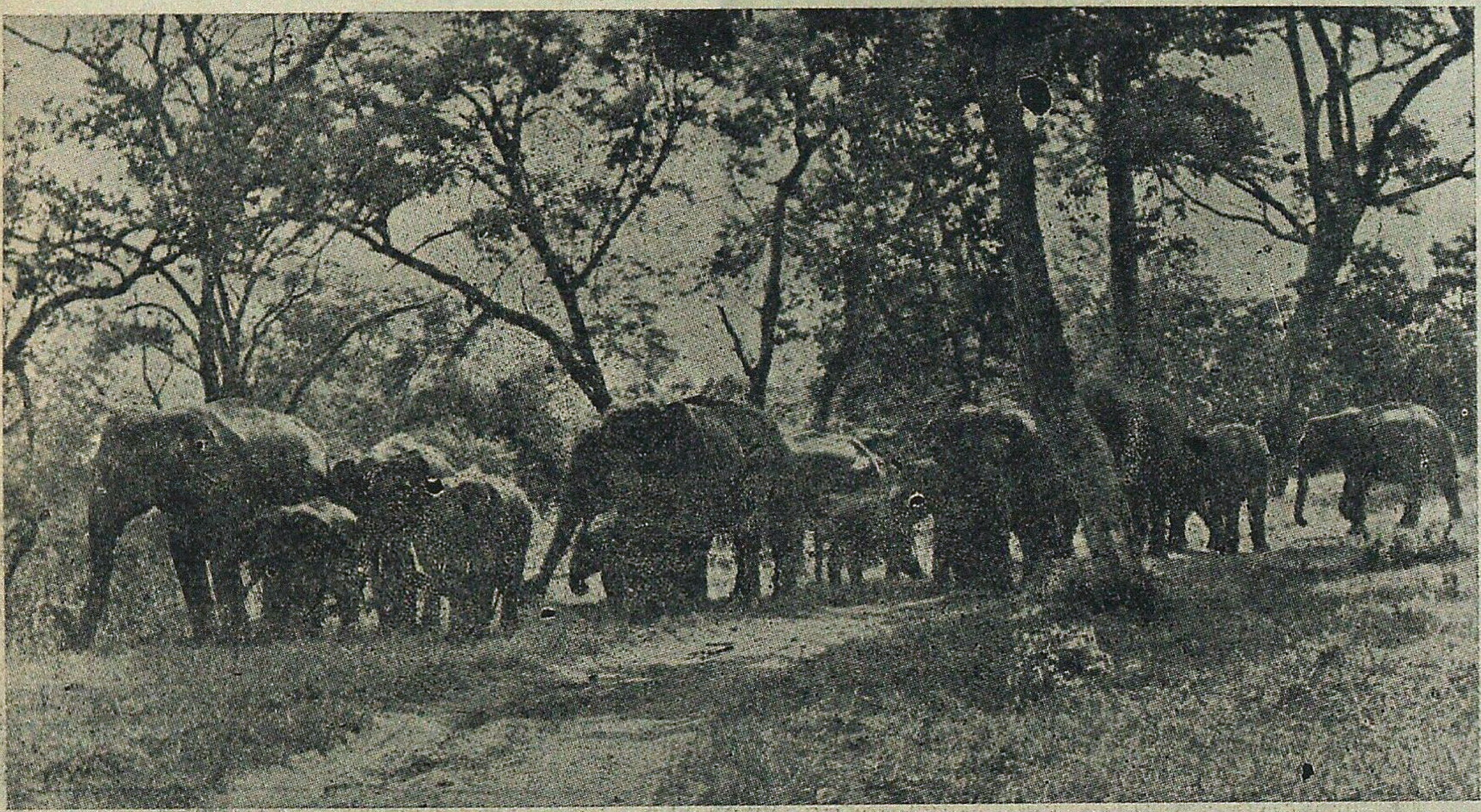

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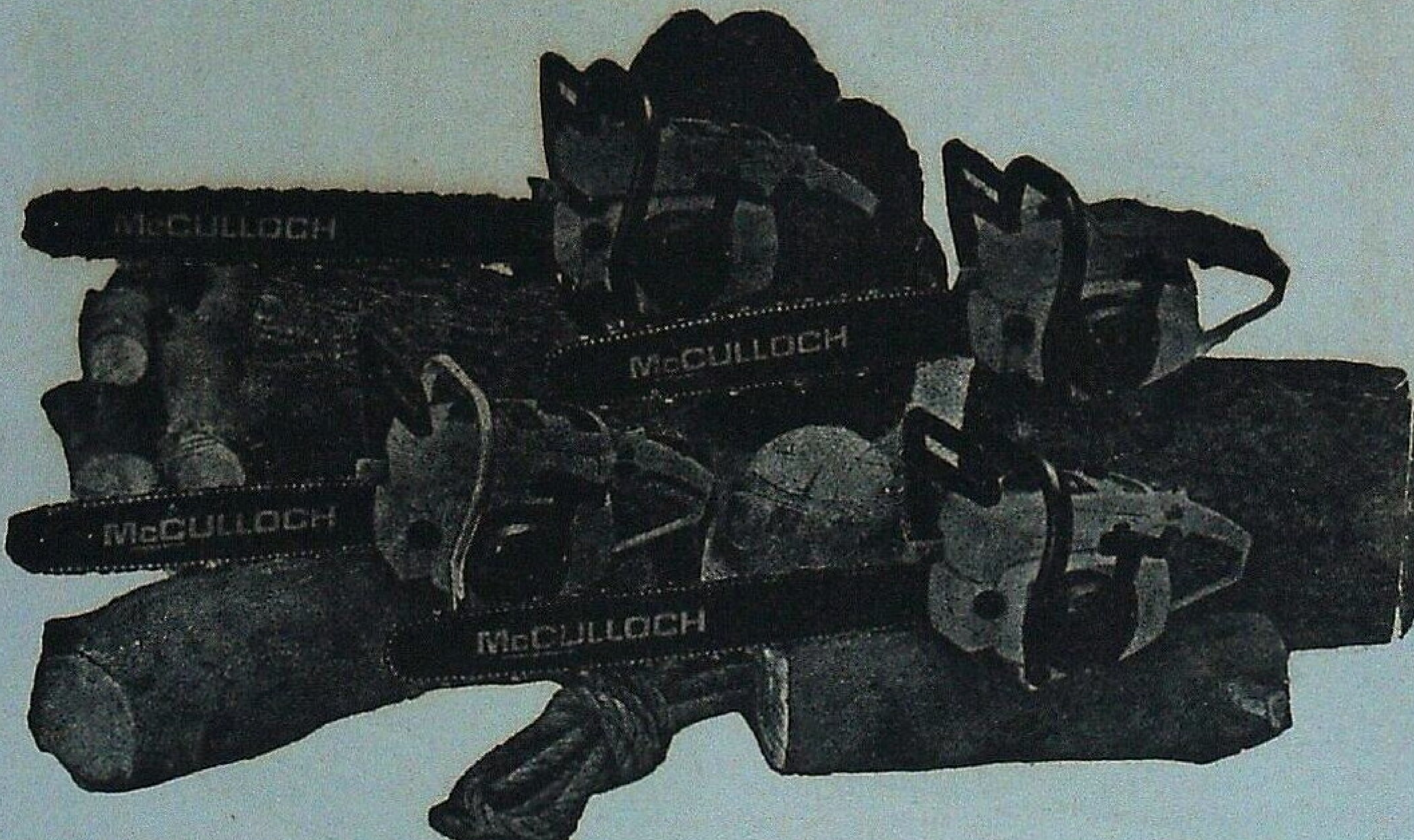

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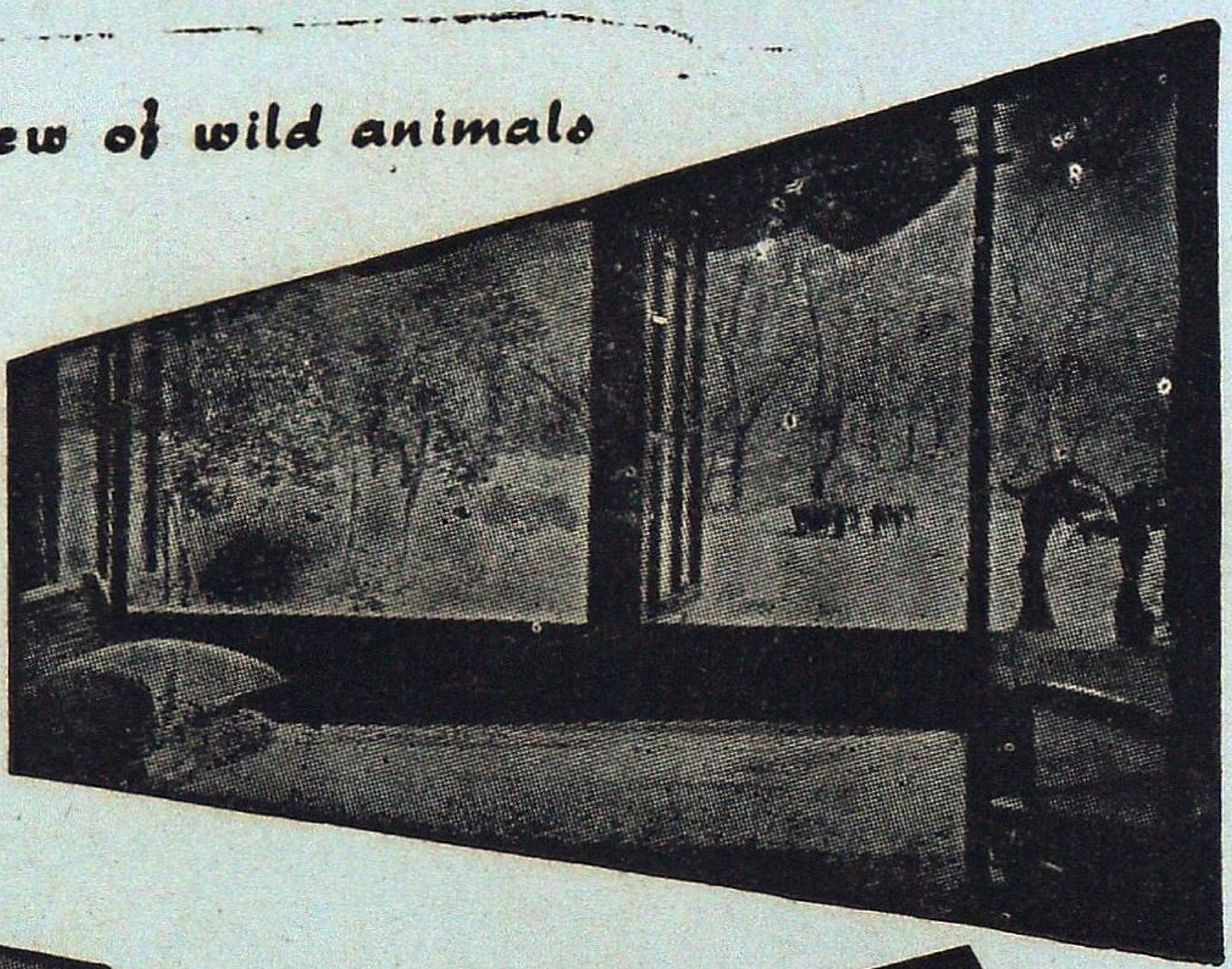

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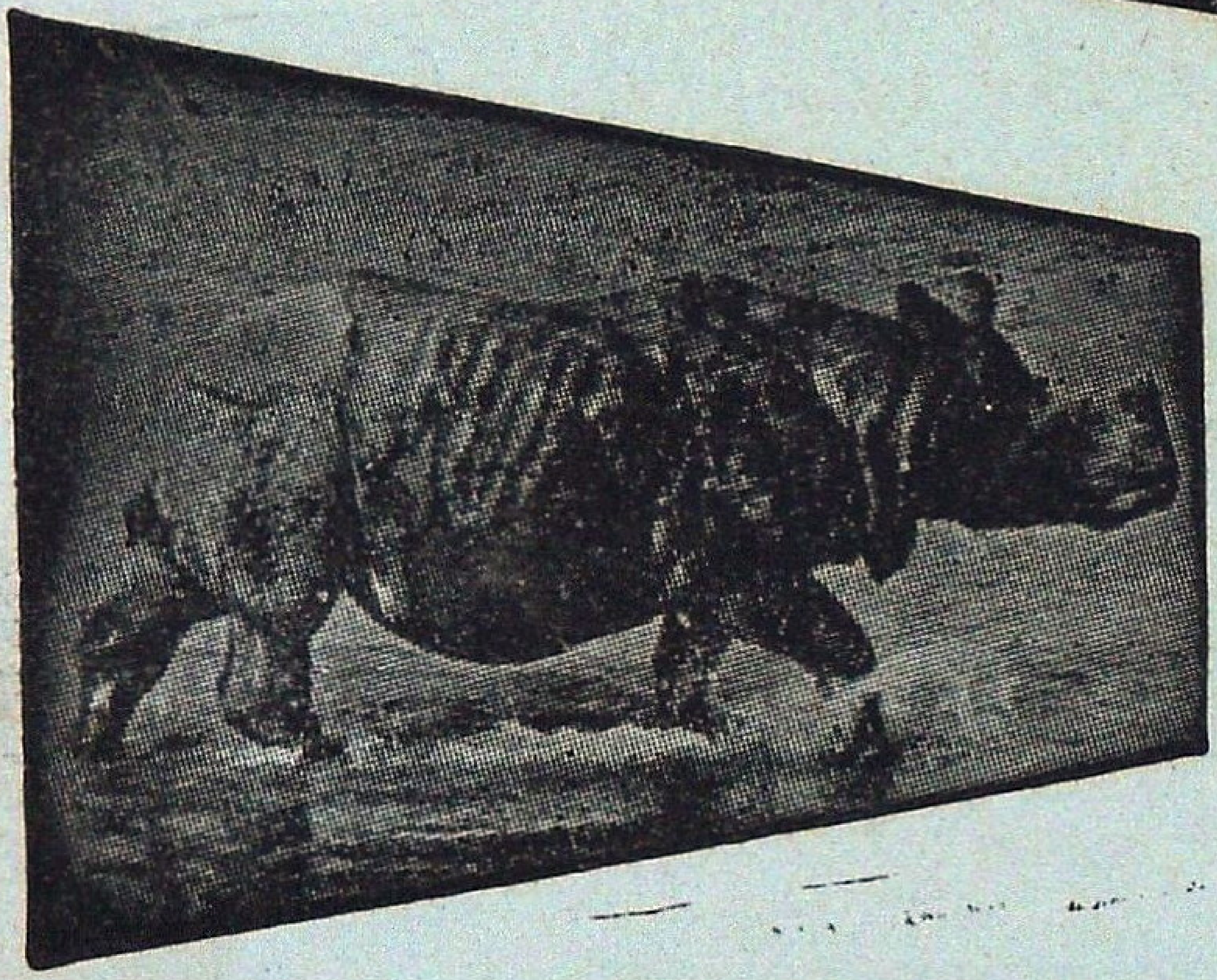

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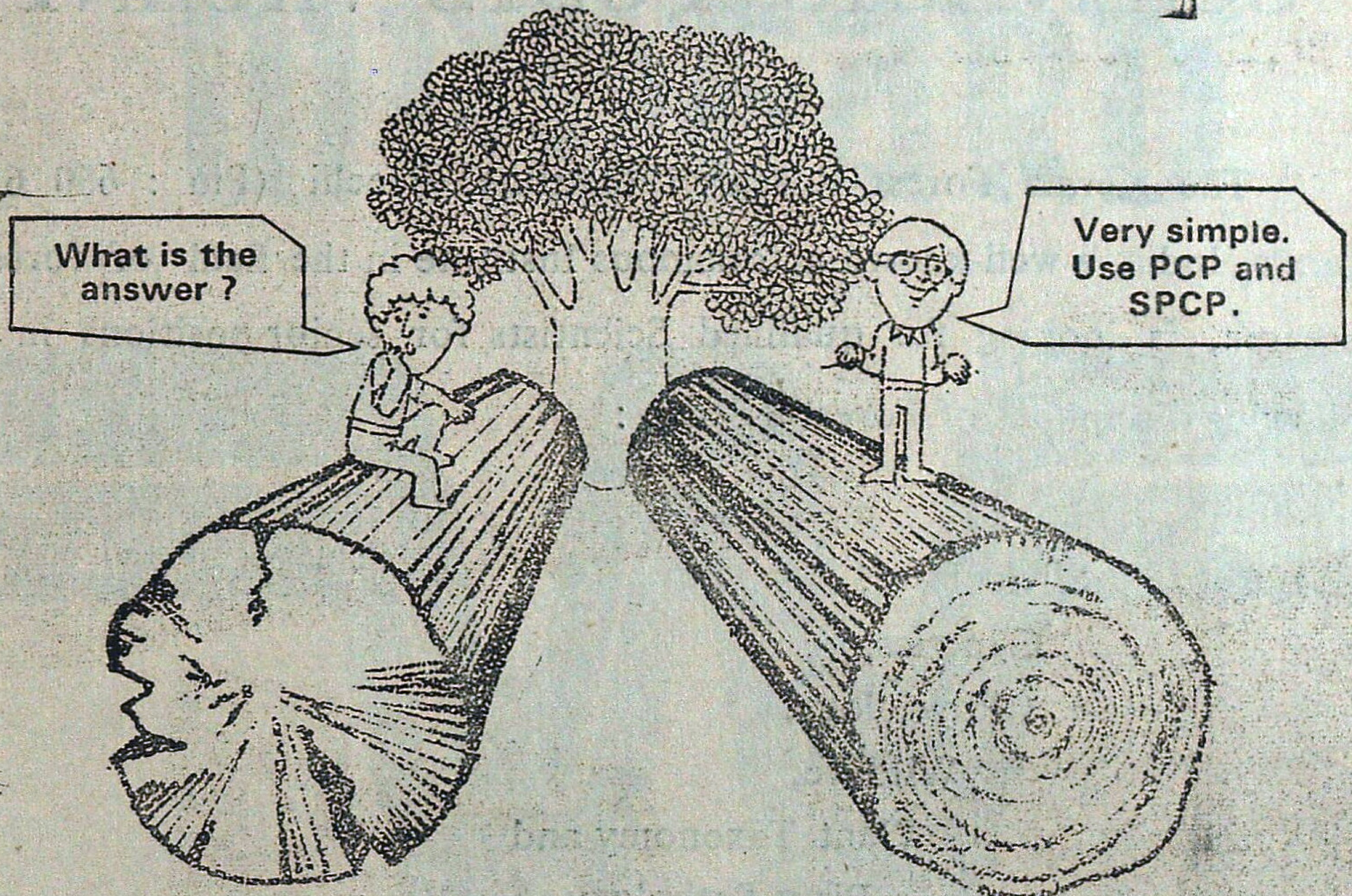

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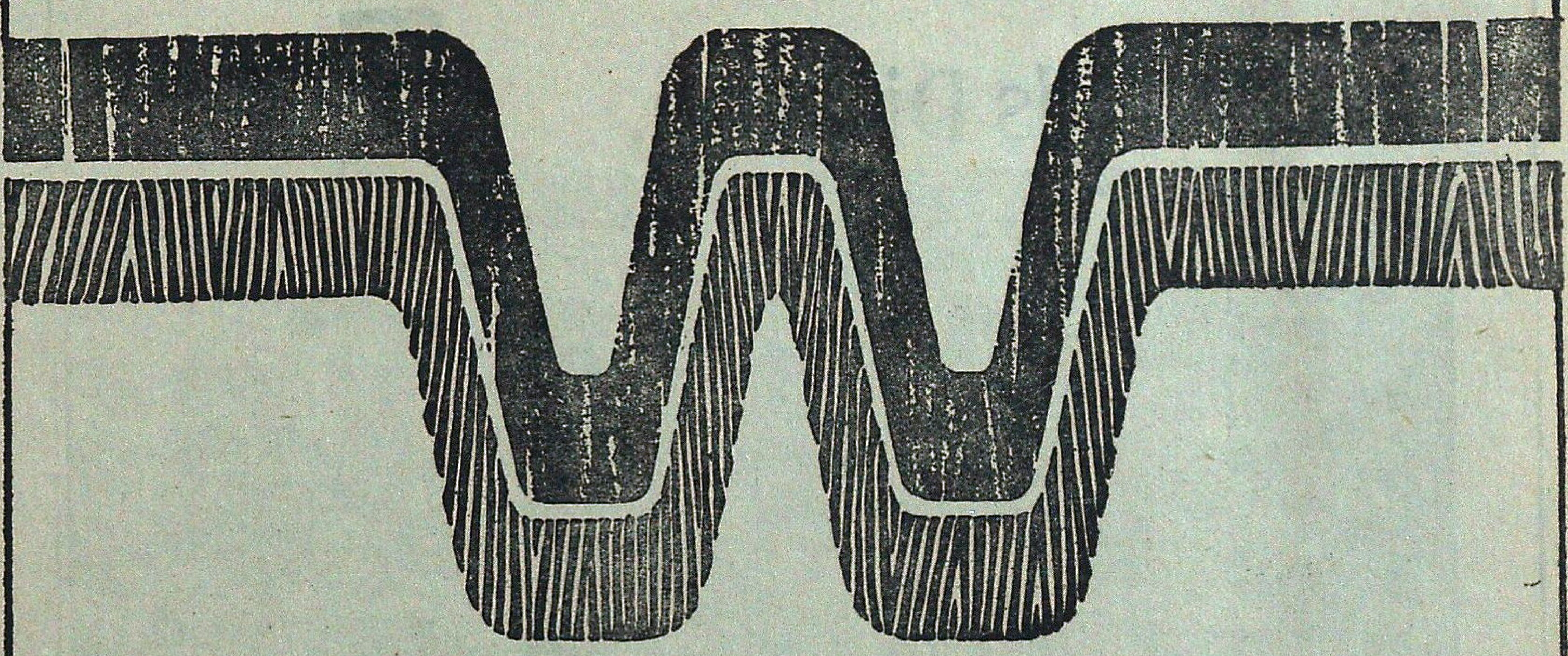

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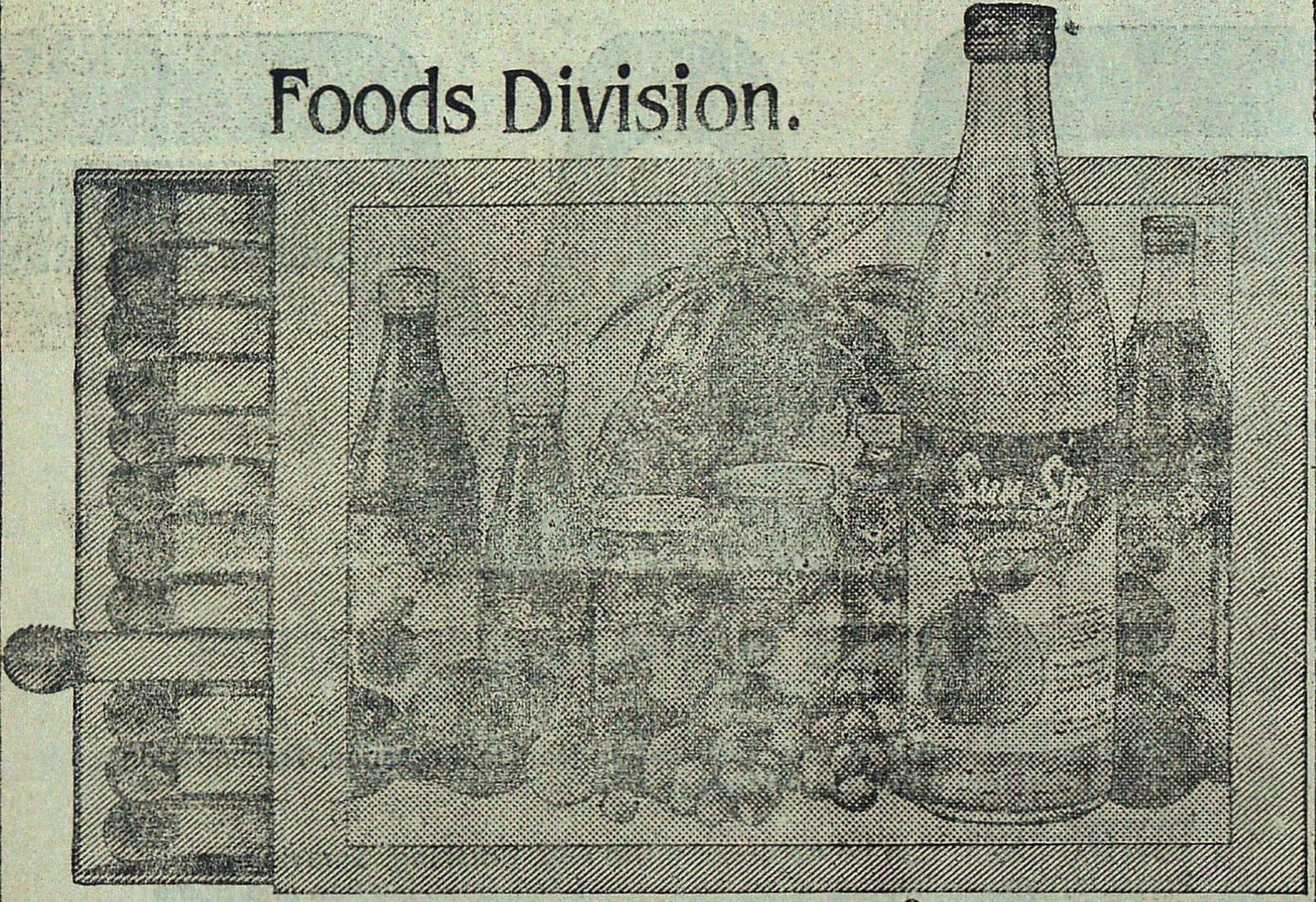

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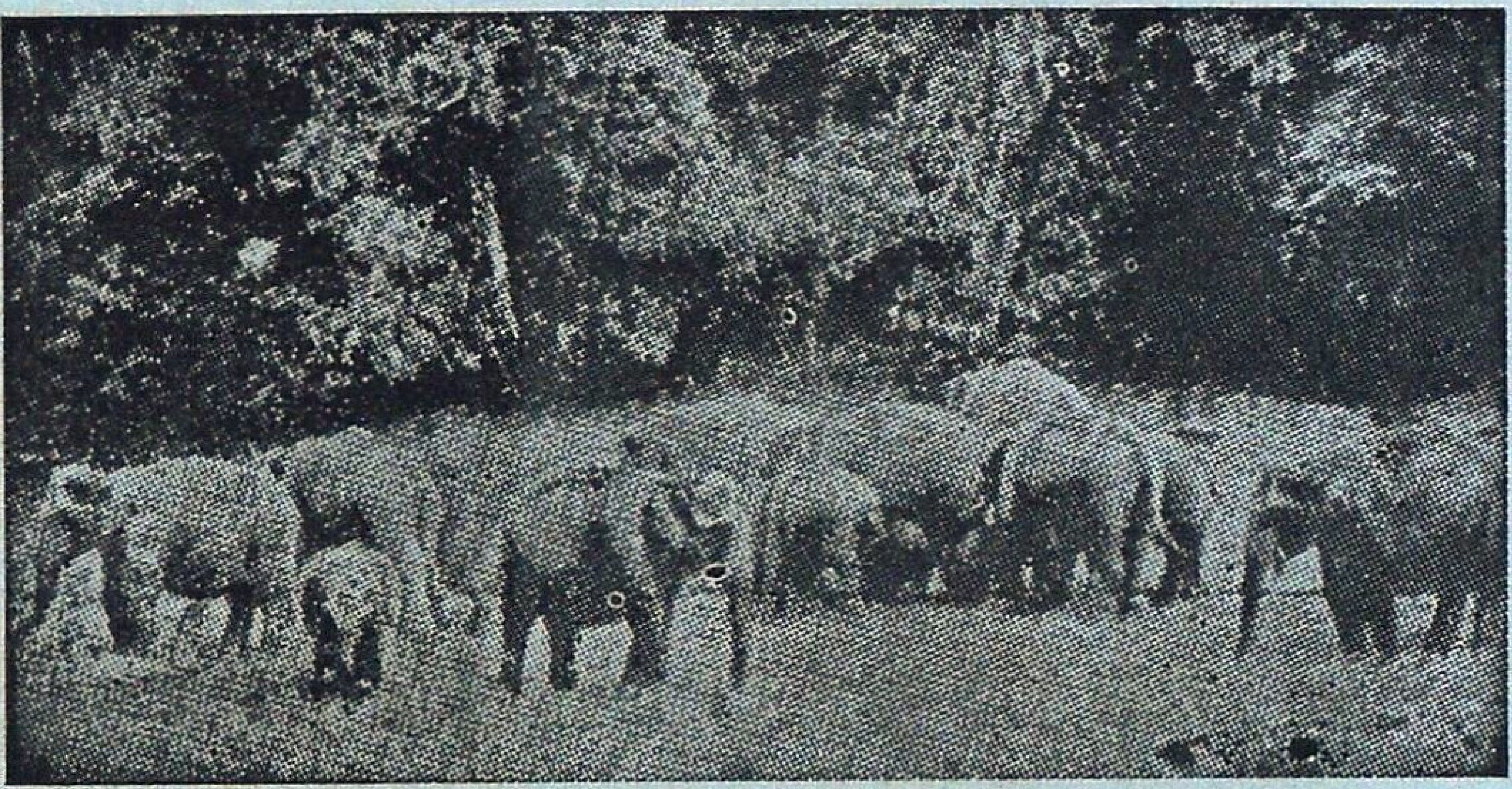

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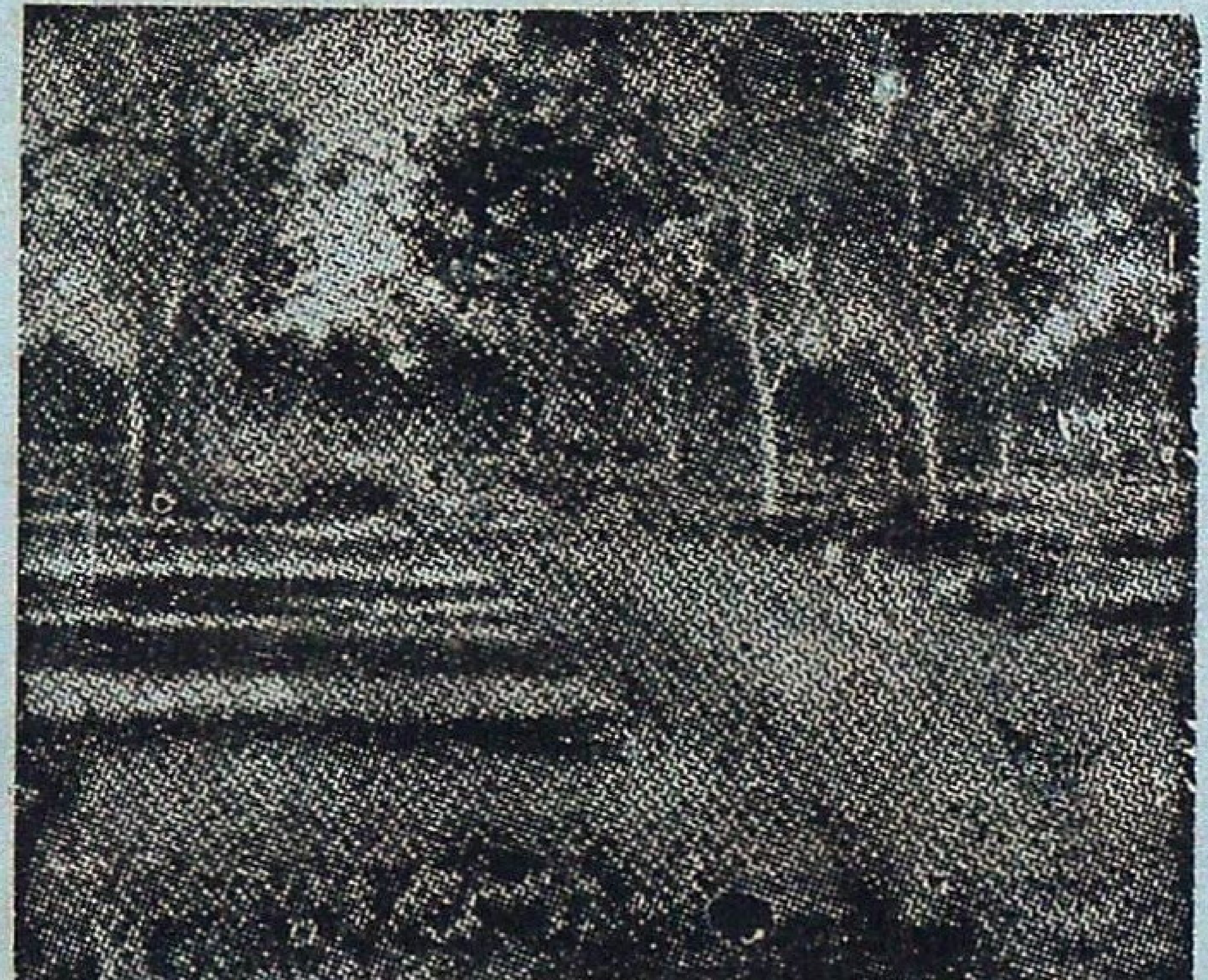

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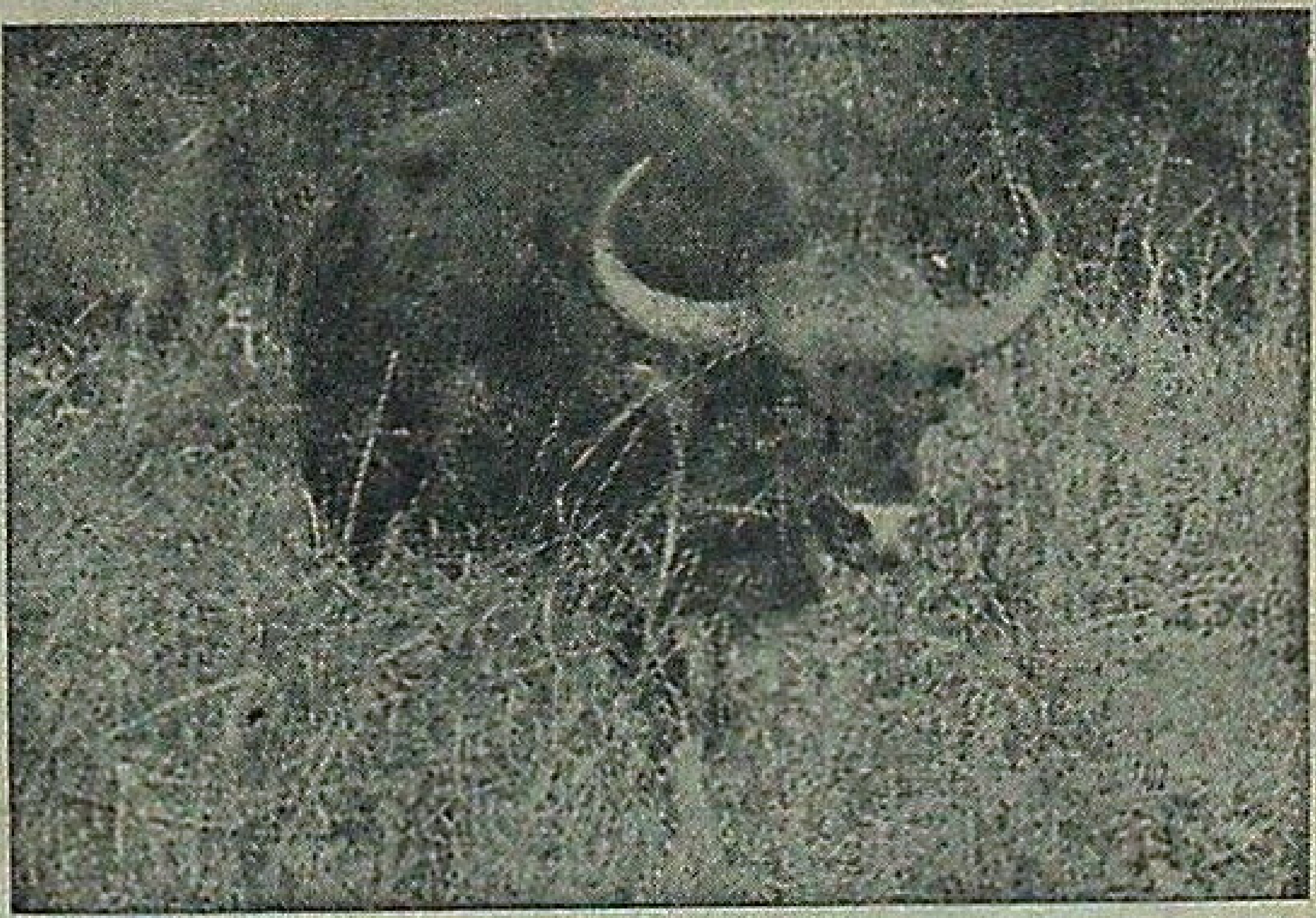

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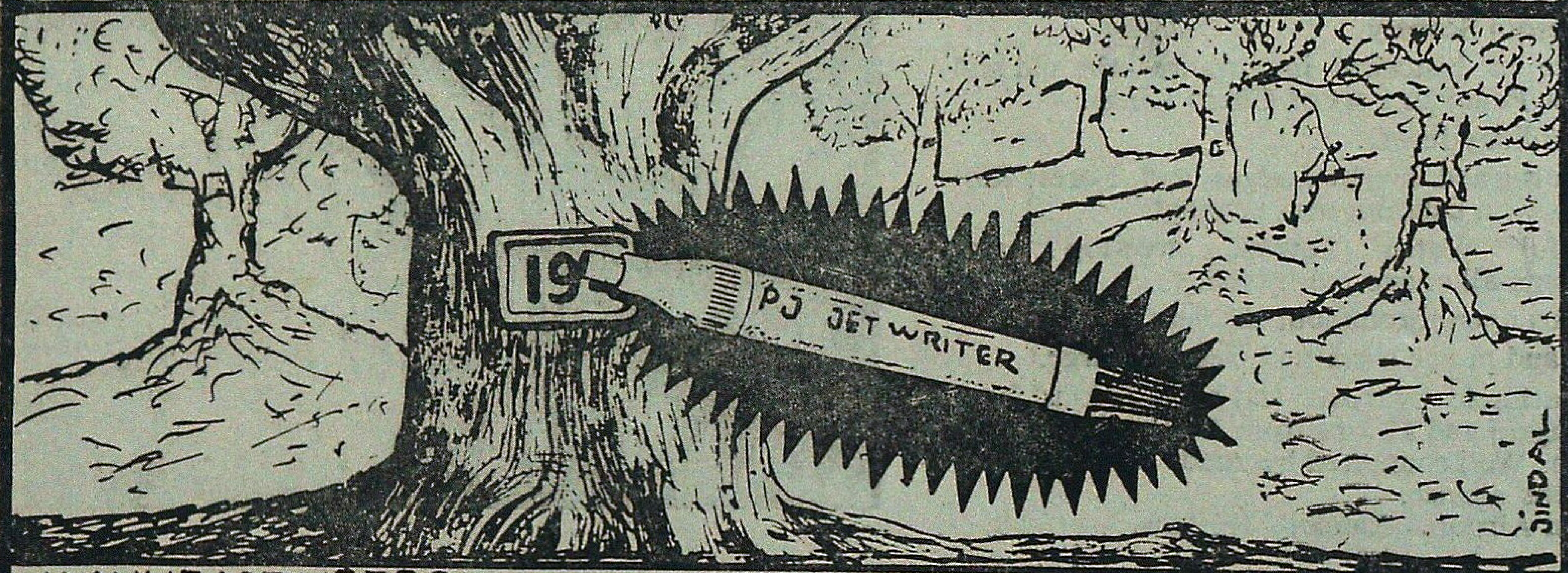

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के
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VOLUME 110 MAY 1984 NUMBER 5

ALPINE PASTURE IN PARBATI VALLEY, HIMACHAL PRADESH. Front Cover
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CONTENTS

EDITORIAL

ARTICLES

GERMINATION BEHAVIOUR OF VARIOUS PROVENANCES OF *ACACIA NILOTICA* SSP. *INDICA*.
R.S. Mathur, K.K. Sharma and M.M.S. Rawat 435

MANAGEMENT OF SPRUCE AND SILVER FIR FORESTS FOR PACKING BOXES SUPPLY IN HIMACHAL PRADESH.
R.V. Singh 450

GROWTH ANALYSIS OF CHIR (*PINUS ROXBURGHII*, SARGENT) PLANTATIONS IN SUPKHAR OF BALAGHAT DIVISION OF MADHYA PRADESH. S.K. Suri 458

PHYSICAL WORK-LOAD IN TREE FELLING AND CROSS CUTTING OPERATIONS. B.P. Maleta and K.G. Sood 478

A NOTE ON THE WORKING QUALITY AND FINISH ADAPTABILITY OF RUBBERWOOD (*HEVEA BRASILIENSIS*)
K.S. Shukla, R.C. Bhatnagar and B.C. Pant 490

AN ABNORMAL SEEDLING IN TEAK.
R.K. Vakshasya and C.J S.K. Emmanuel 497

TWO NEW SPECIES OF *HIPTAGE* GAERTN. (MALPIGHIACEAE) FROM INDIA. R.C. Srivastava 499

A NOTE ON PHYSICAL AND MECHANICAL PROPERTIES OF *LAGERSTROEMIA SPECIOSA* (JARUL) FROM KERALA.
J.D. Jain and M.N. Dangwal... 503

EUCALYPTUS TRIALS FOR RURAL FIREWOOD PLANTATION IN BIHAR. Upendra Prasad... 510

A NEW SPECIES OF *PILEOSTEGIA* HOOK. f. & Th. (HYDRANGEACEAE) FROM ARUNACHAL PRADESH (INDIA)
H.B. Naithani and S.S.R. Bennet 518

GAZETTE NOTIFICATIONS ix

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